501P1118

FIG. 1

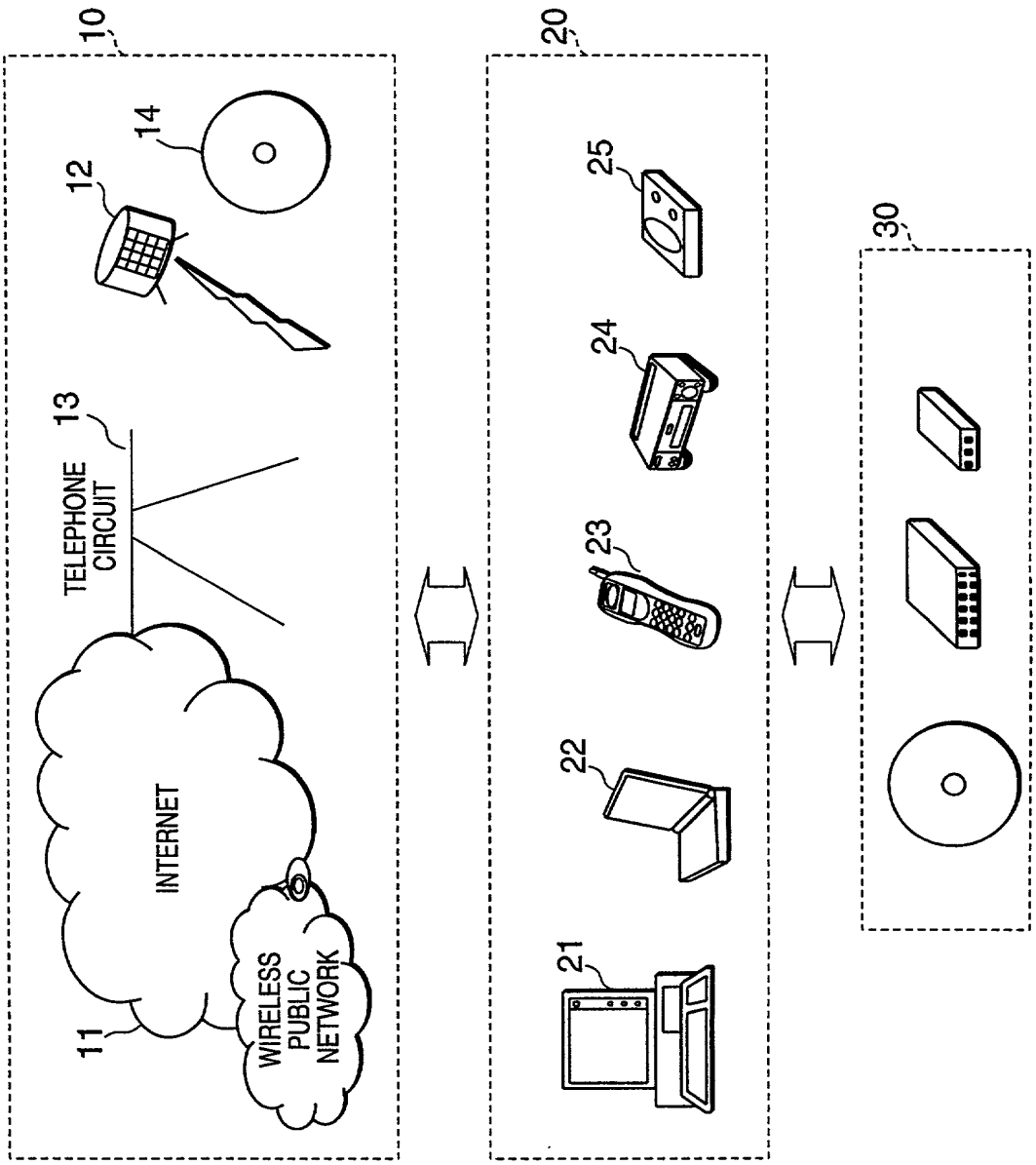


FIG. 2

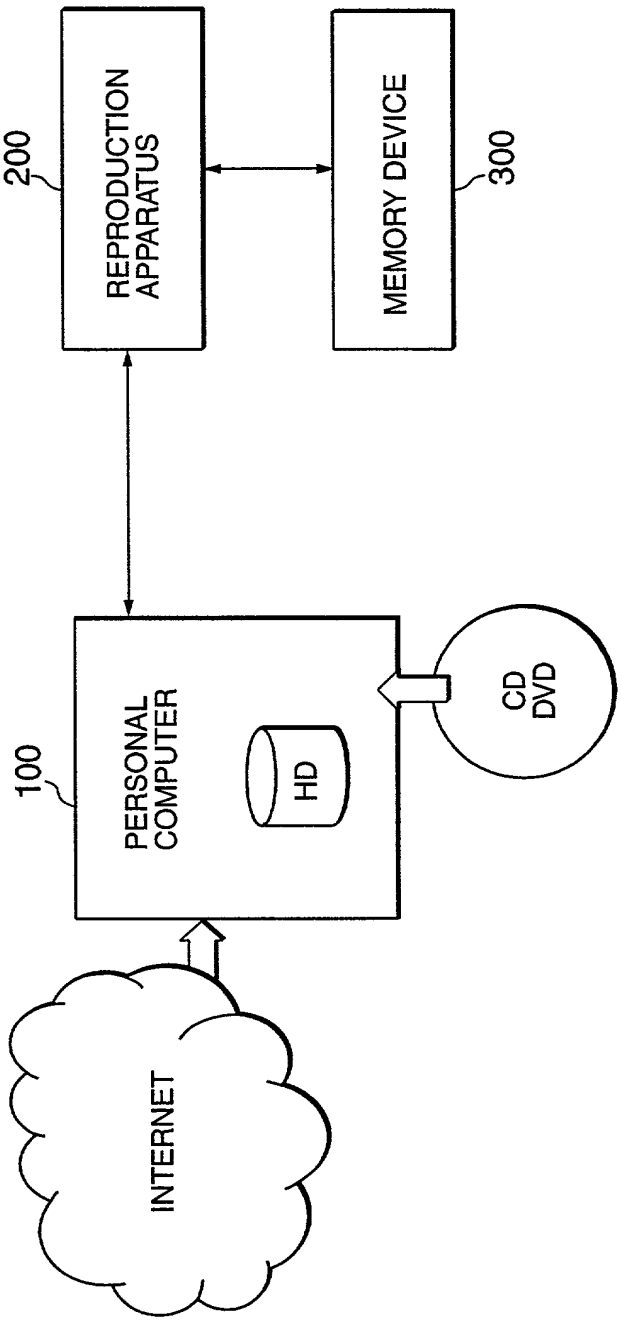

200
REPRODUCTION APPARATUS
MEMORY DEVICE
300
100
PERSONAL COMPUTER
HD
CD DVD
INTERNET

FIG. 3

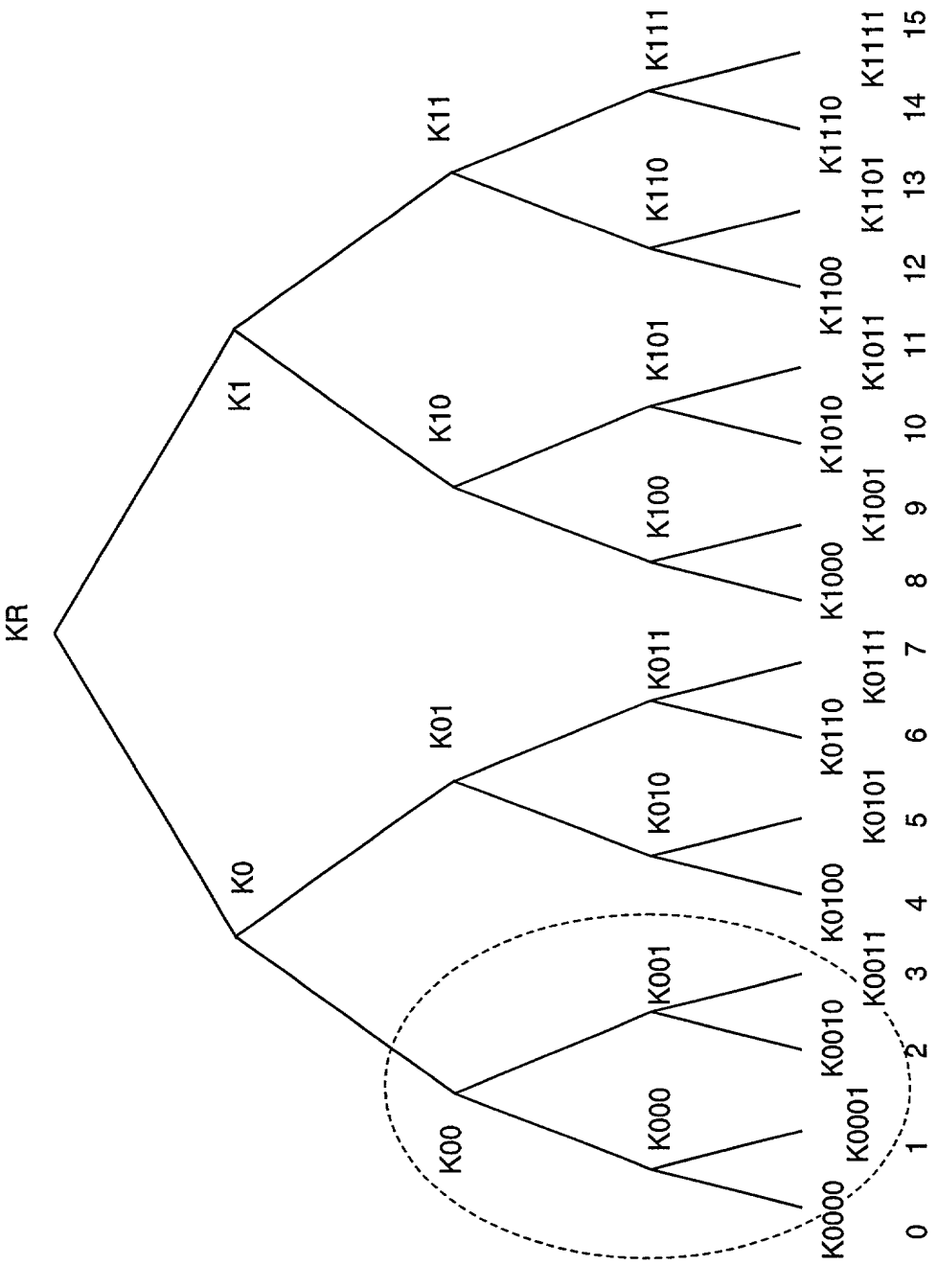

KR
K0
K1
K00
K01
K10
K11
K000
K001
K010
K011
K100
K101
K110
K111
K0000
K0001
K0010
K0011
K0100
K0101
K0110
K0111
K1000
K1001
K1010
K1011
K1100
K1101
K1110
K1111
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
DEVICES

FIG. 4

(A)

EKB (ENABLING KEY BLOCK) EXAMPLE 1
DELIVERS NODE KEYS OF VERSION (t) TO DEVICES 0, 1,AND 2

VERSION : t	
INDEX	ENCIPHERING KEY
0	Enc(K(t)0, K(t)R)
00	Enc(K(t)00, K(t)0)
000	Enc(K000, K(t)00)
001	Enc(K(t)001, K(t)00)
0010	Enc(K0010, K(t)001)

(B)

EKB (ENABLING KEY BLOCK) EXAMPLE 2
DELIVER NODE KEY OF VERSION (t) TO DEVICES 0, 1, AND 2

VERSION : t	
INDEX	ENCIPHERING KEY
000	Enc(K000, K(t)00)
001	Enc(K(t)001, K(t)00)
0010	Enc(K0010, K(t)001)

FUNAI 2020-1-DOC

FIG. 5

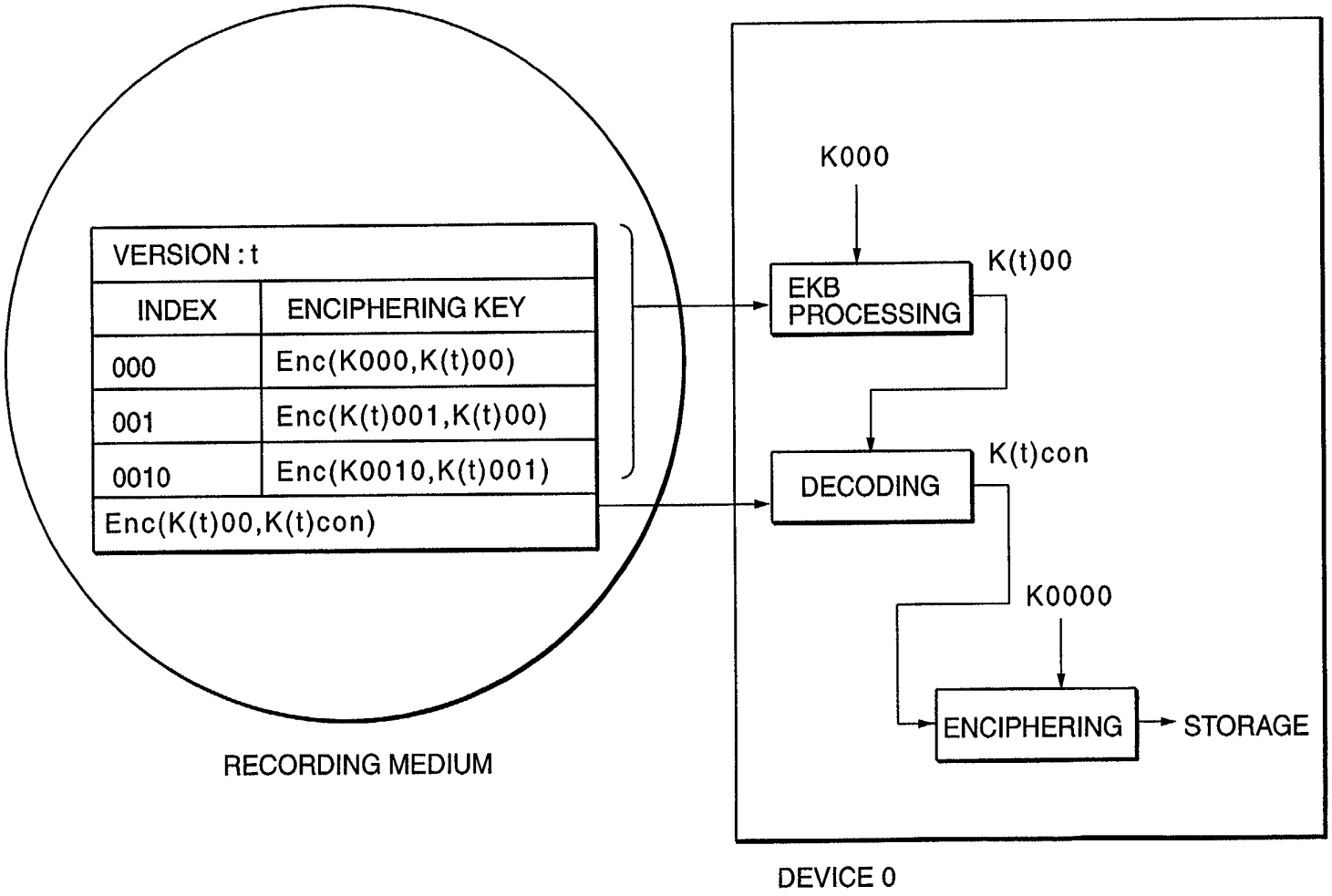


FIG. 6

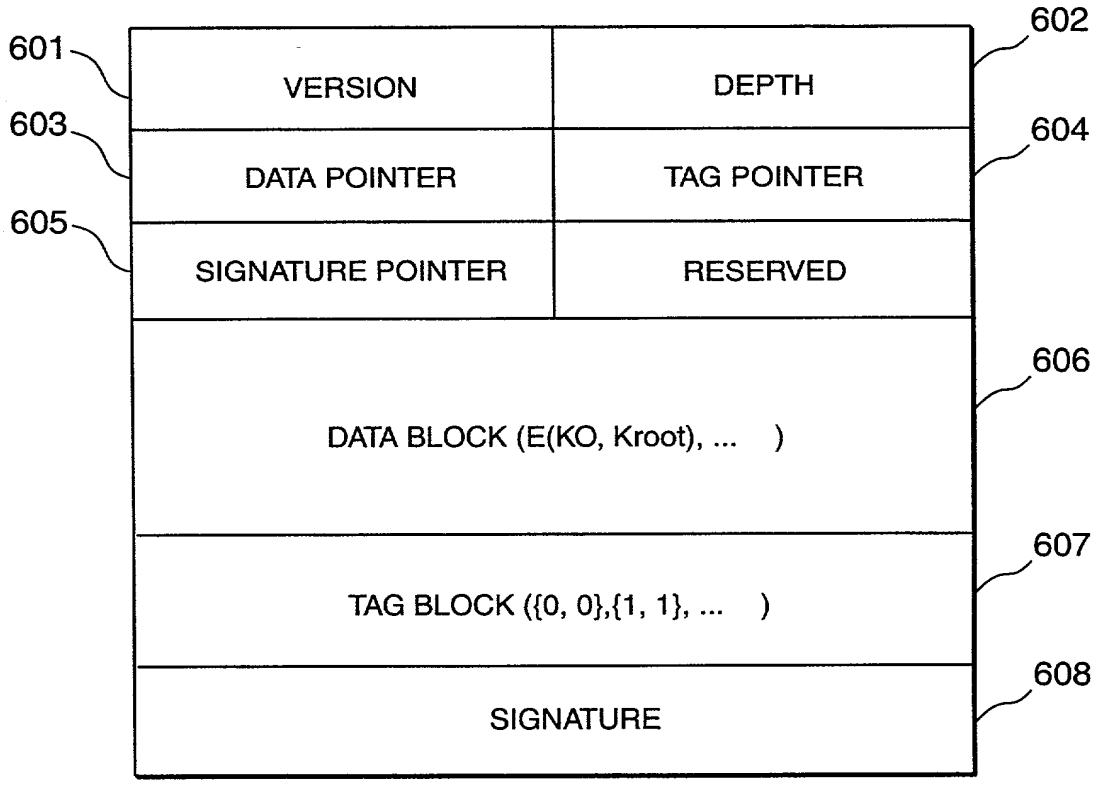

601
602
VERSION
DEPTH
603
604
DATA POINTER
TAG POINTER
605
SIGNATURE POINTER
RESERVED
606
DATA BLOCK (E(KO, Kroot), ...)
607
TAG BLOCK ({0, 0},{1, 1}, ...)
608
SIGNATURE

FIG. 7

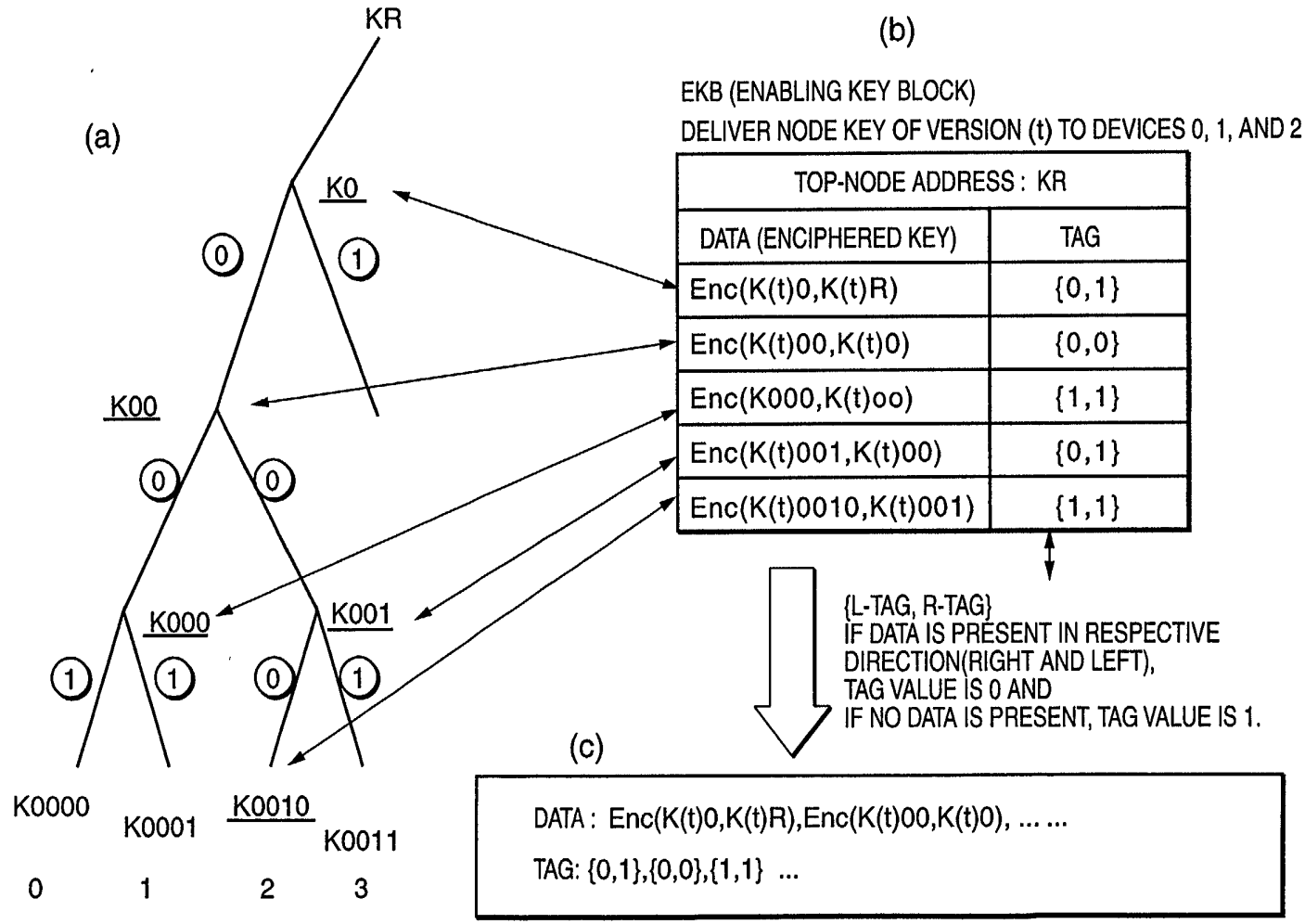

KR
(a)
K0
0
1
K00
0
0
K000
K001
1
1
0
1
K0000
K0001
K0010
K0011
0
1
2
3
(b)
EKB (ENABLING KEY BLOCK)
DELIVER NODE KEY OF VERSION (t) TO DEVICES 0, 1, AND 2
TOP-NODE ADDRESS : KR
DATA (ENCIPHERED KEY)
TAG
Enc(K(t)0,K(t)R)
{0,1}
Enc(K(t)00,K(t)0)
{0,0}
Enc(K000,K(t)oo)
{1,1}
Enc(K(t)001,K(t)00)
{0,1}
Enc(K(t)0010,K(t)001)
{1,1}
{L-TAG, R-TAG}
IF DATA IS PRESENT IN RESPECTIVE DIRECTION(RIGHT AND LEFT),
TAG VALUE IS 0 AND
IF NO DATA IS PRESENT, TAG VALUE IS 1.
(c)
DATA : Enc(K(t)0,K(t)R),Enc(K(t)00,K(t)0), ...
TAG: {0,1},{0,0},{1,1} ...

FIG. 8

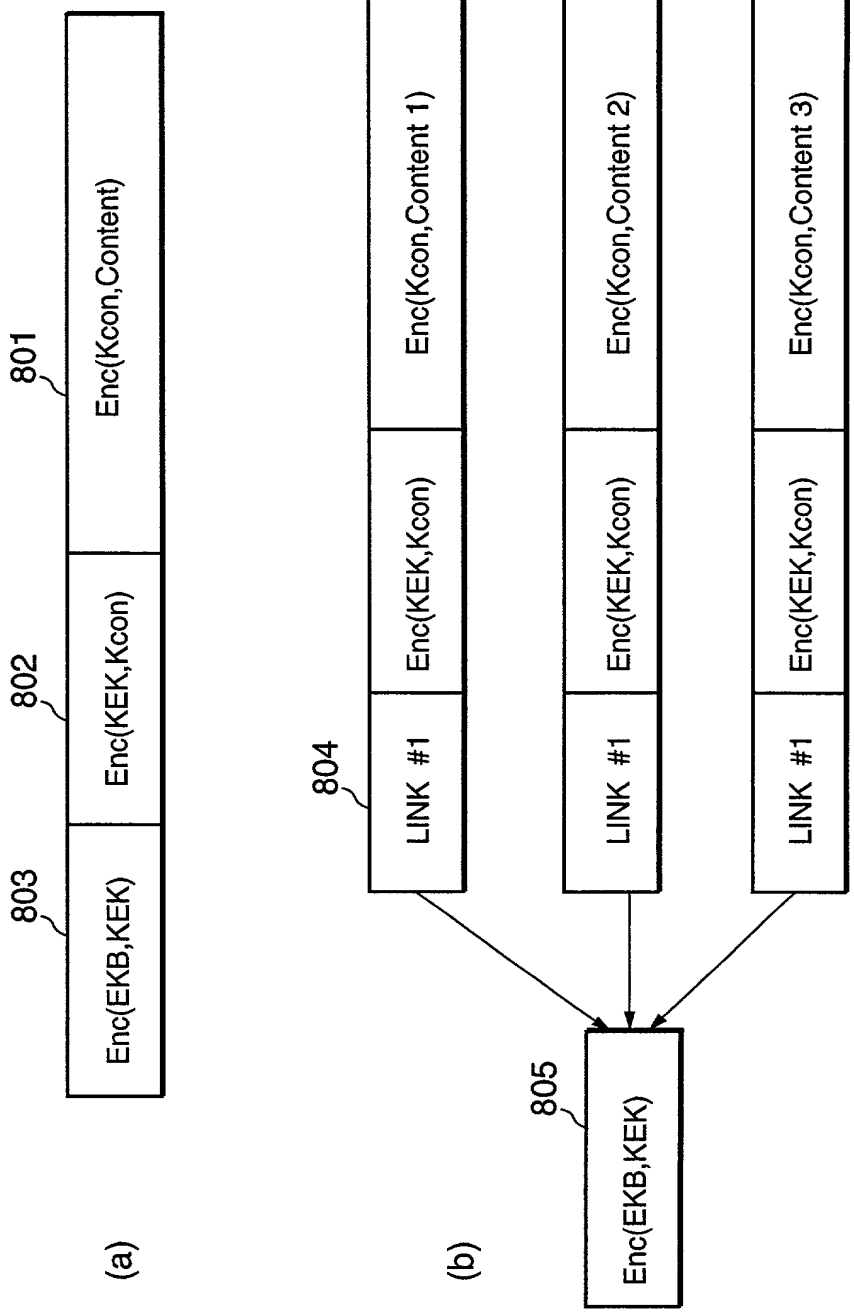

(a)
803
Enc(EKB,KEK)
802
Enc(KEK,Kcon)
801
Enc(Kcon,Content)
(b)
804
LINK #1
Enc(KEK,Kcon)
Enc(Kcon,Content 1)
LINK #1
Enc(KEK,Kcon)
Enc(Kcon,Content 2)
LINK #1
Enc(KEK,Kcon)
Enc(Kcon,Content 3)
805
Enc(EKB,KEK)

FIG. 9

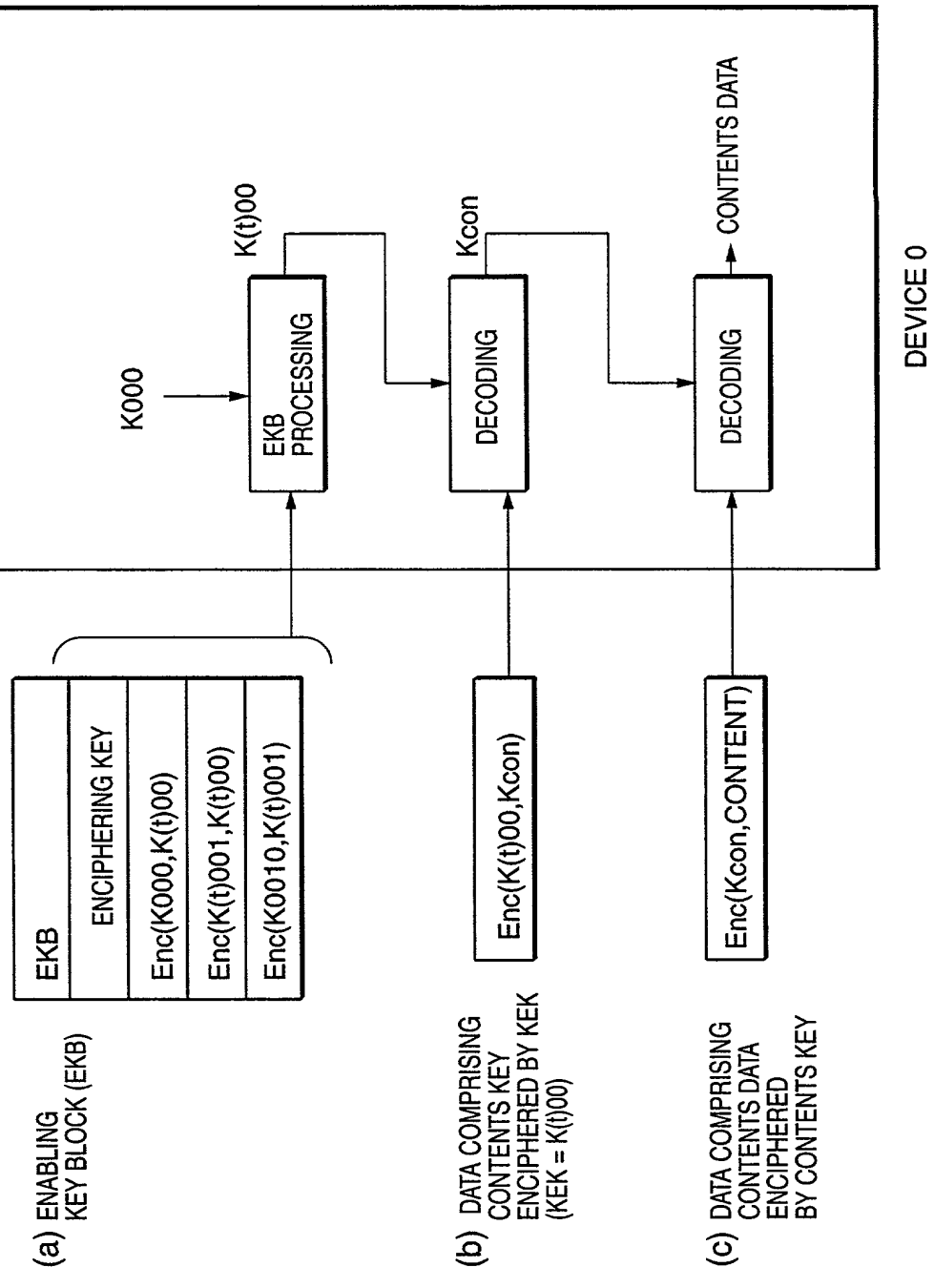
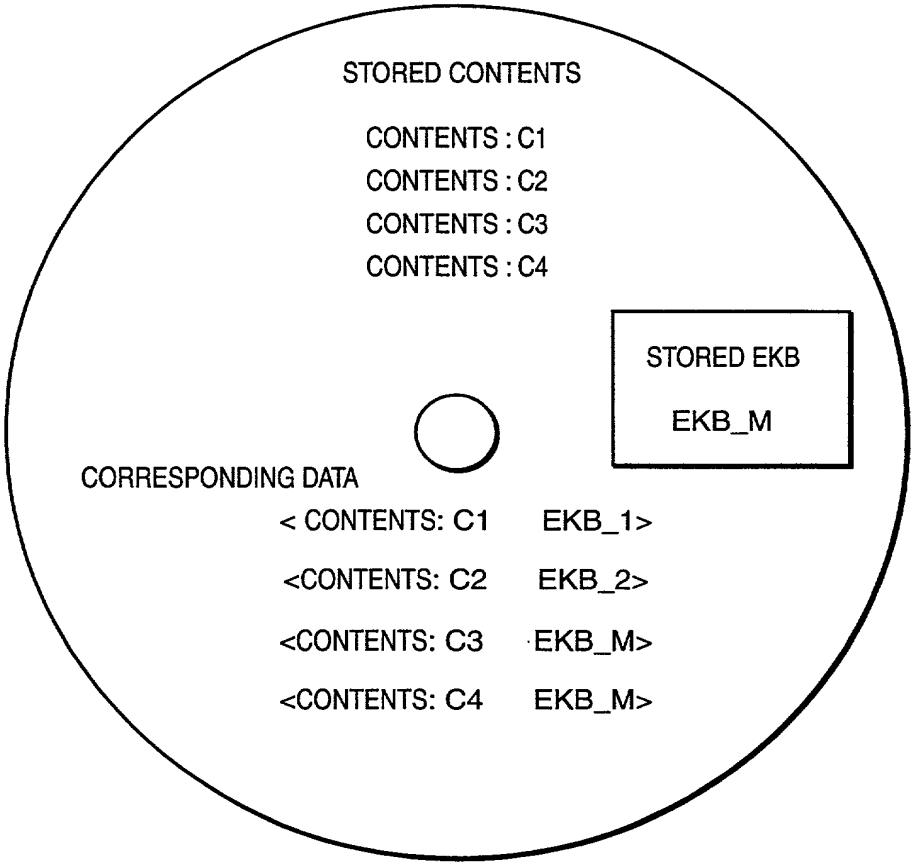

(a) ENABLING KEY BLOCK (EKB)
EKB
ENCIPHERING KEY
Enc(K000,K(t)00)
Enc(K(t)001,K(t)00)
Enc(K0010,K(t)001)
(b) DATA COMPRISING CONTENTS KEY ENCIPHERED BY KEK (KEK = K(t)00)
Enc(K(t)00,Kcon)
(c) DATA COMPRISING CONTENTS DATA ENCIPHERED BY CONTENTS KEY
Enc(Kcon,CONTENT)
K000
EKB PROCESSING
K(t)00
DECODING
Kcon
DECODING
CONTENTS DATA
DEVICE 0

FIG. 10



RECORDING MEDIUM

FIG. 11

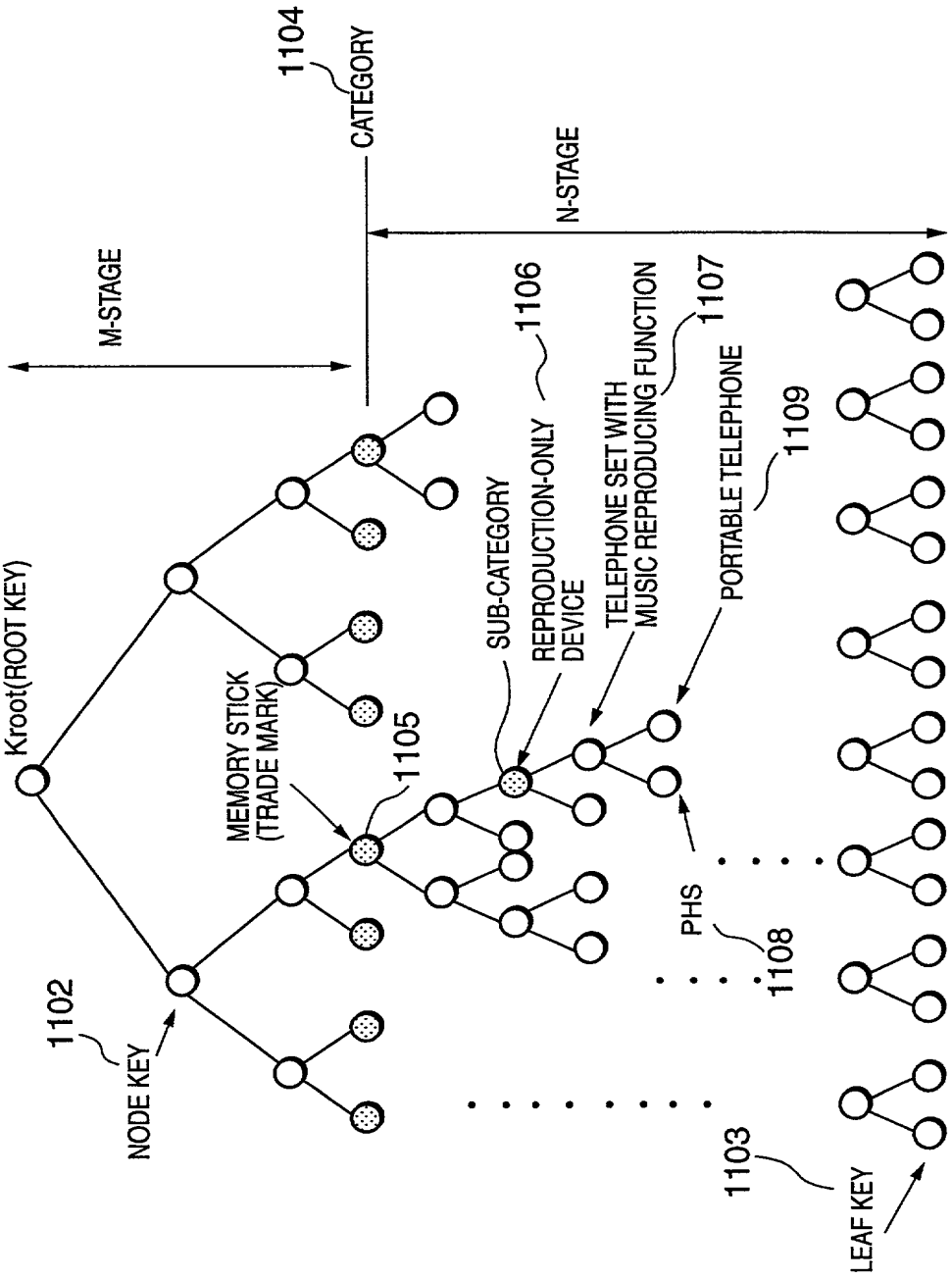
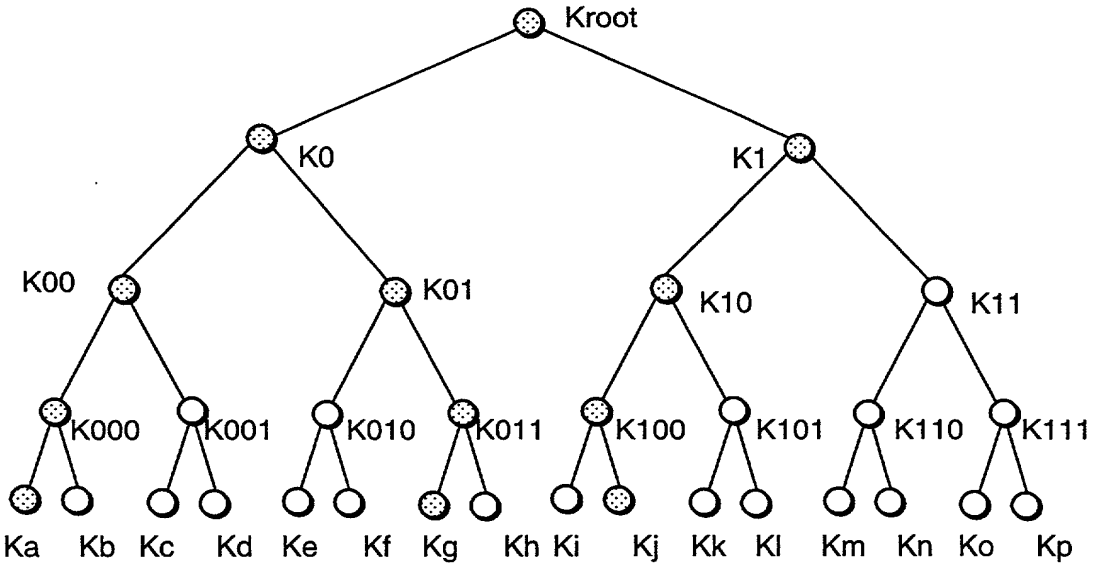

1101
Kroot(ROOT KEY)
M-STAGE
1104
CATEGORY
N-STAGE
1102
NODE KEY
MEMORY STICK
(TRADE MARK)
1105
SUB-CATEGORY
1106
REPRODUCTION-ONLY
DEVICE
TELEPHONE SET WITH
MUSIC REPRODUCING FUNCTION
1107
PORTABLE TELEPHONE
1109
PHS
1108
1103
LEAF KEY

FIG. 12

(a)


Kroot
K0
K1
K00
K01
K10
K11
K000
K001
K010
K011
K100
K101
K110
K111
Ka
Kb
Kc
Kd
Ke
Kf
Kg
Kh
Ki
Kj
Kk
Kl
Km
Kn
Ko
Kp

(b)

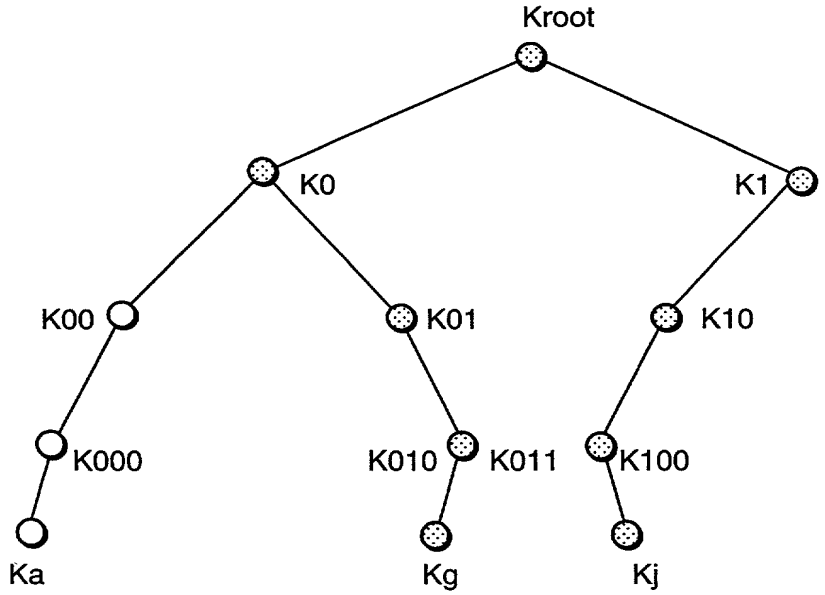
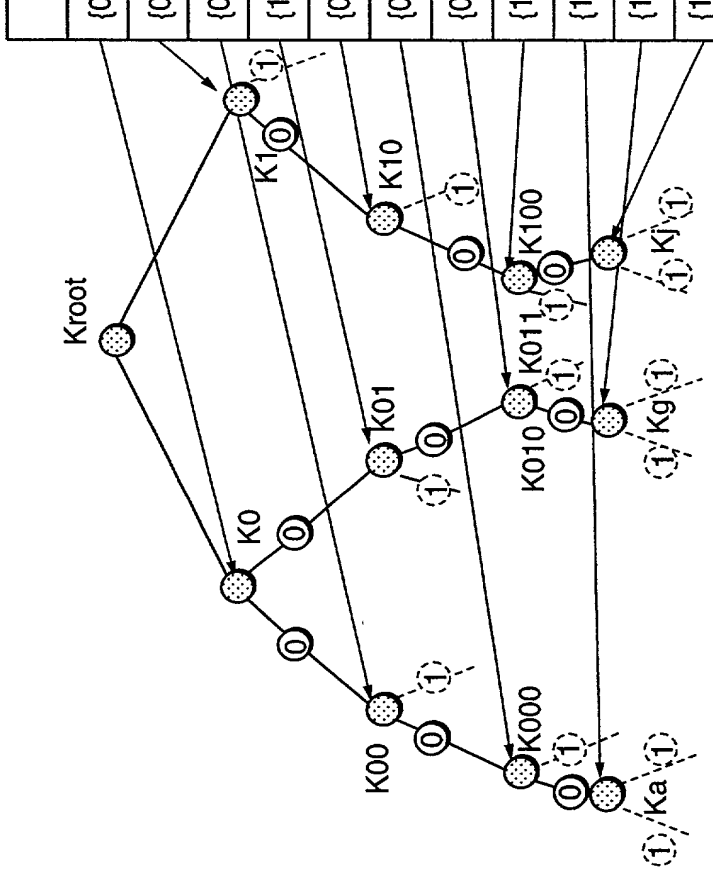

Kroot
K0
K1
K00
K01
K10
K000
K010
K011
K100
Ka
Kg
Kj

FIG. 13

(a)

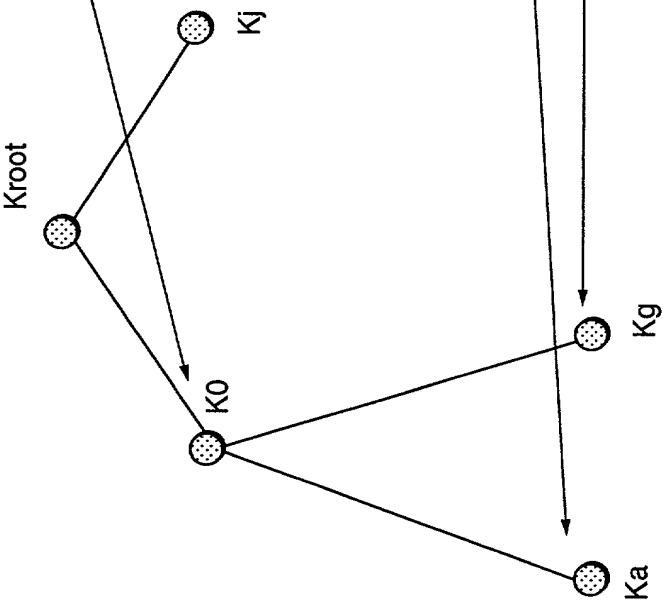


(b)

TAG	DATA(ENCIPHERING KEY)
{0, 0}	Enc(K(t)0,K(t)root)
{0, 1}	Enc(K(t)1,K(t)root)
{0, 1}	Enc(K(t)00,K(t)0)
{1, 0}	Enc(K(t)01,K(t)0)
{0, 1}	Enc(K(t)10,K(t)1)
{0, 1}	Enc(K(t)000,K(t)00)
{0, 1}	Enc(K(t)011,K(t)01)
{1, 0}	Enc(K(t)100,K(t)10)
{1, 1}	Enc(Ka,K(t)000)
{1, 1}	Enc(Kg,K(t)011)
{1, 1}	Enc(Kj,K(t)100)
{1, 1}	Enc(K(t)root, K(t)con)

FIG. 14

(a)



(b)

TAG	DATA(ENCIPHERING KEY)
{0, 0, 1}	Enc(K(t)0,K(t)root)
{0, 1, 0}	—
{0, 1, 0}	—
{1, 0, 0}	—
{0, 1, 0}	—
{0, 1, 0}	—
{0, 1, 0}	—
{1, 0, 0}	—
{1, 1, 1}	Enc(Ka,K(t)0)
{1, 1, 1}	Enc(Kg,K(t)0)
{1, 1, 1}	Enc(Kj,K(t)root)
{1, 1, 1}	Enc(K(t)root, K(t)con)

FIG. 15

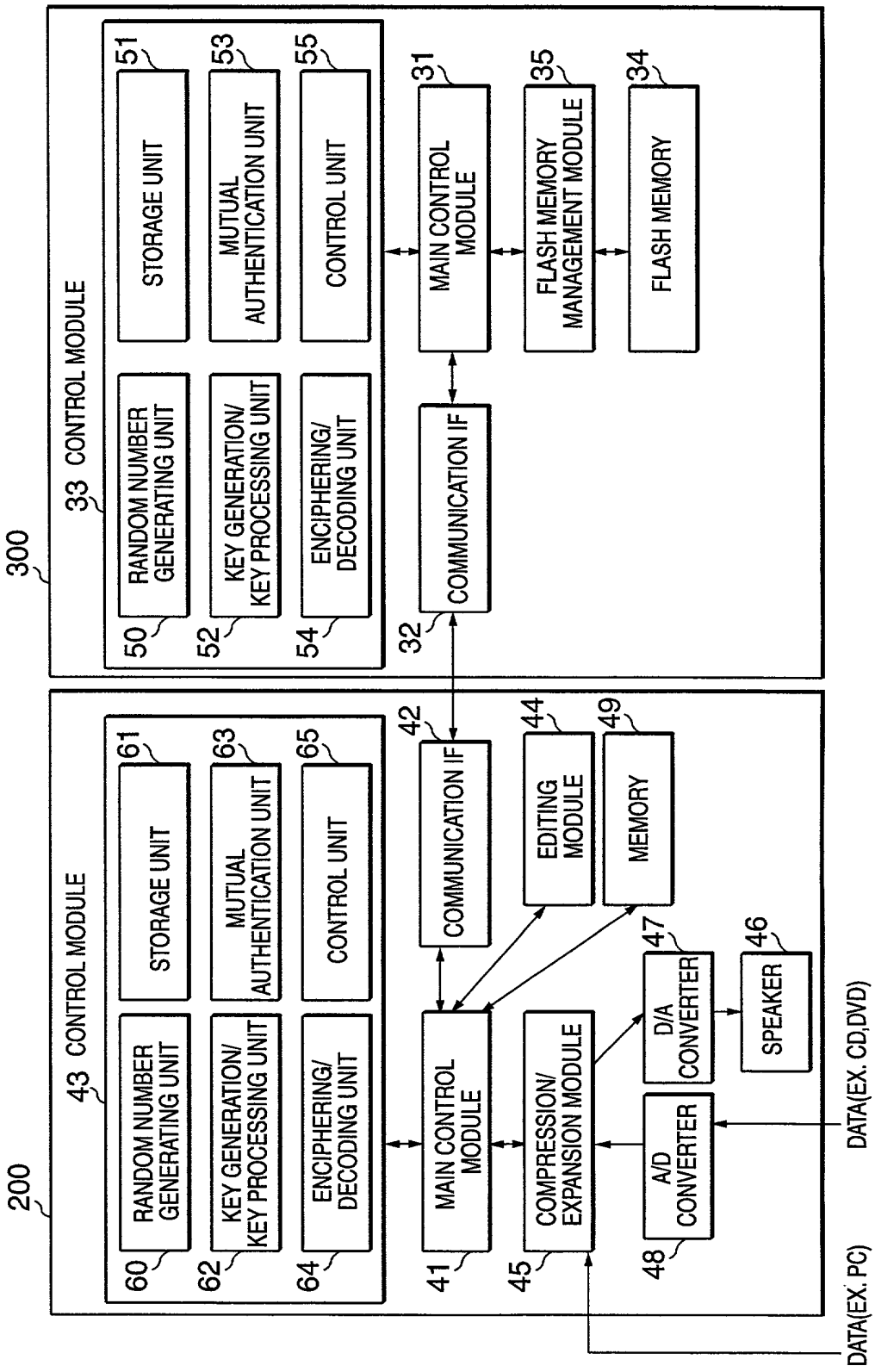

200
43 CONTROL MODULE
RANDOM NUMBER GENERATING UNIT
60
STORAGE UNIT
61
KEY GENERATION/ KEY PROCESSING UNIT
62
MUTUAL AUTHENTICATION UNIT
63
ENCIPHERING/ DECODING UNIT
64
CONTROL UNIT
65
MAIN CONTROL MODULE
41
COMMUNICATION IF
42
COMPRESSION/ EXPANSION MODULE
45
EDITING MODULE
44
MEMORY
49
A/D CONVERTER
48
D/A CONVERTER
47
SPEAKER
46
DATA(EX. PC)
DATA(EX. CD,DVD)
300
33 CONTROL MODULE
RANDOM NUMBER GENERATING UNIT
50
STORAGE UNIT
51
KEY GENERATION/ KEY PROCESSING UNIT
52
MUTUAL AUTHENTICATION UNIT
53
ENCIPHERING/ DECODING UNIT
54
CONTROL UNIT
55
COMMUNICATION IF
32
MAIN CONTROL MODULE
31
FLASH MEMORY MANAGEMENT MODULE
35
FLASH MEMORY
34

FIG. 16

DATA STORED IN A STORAGE UNIT OF A MEMORY DEVICE

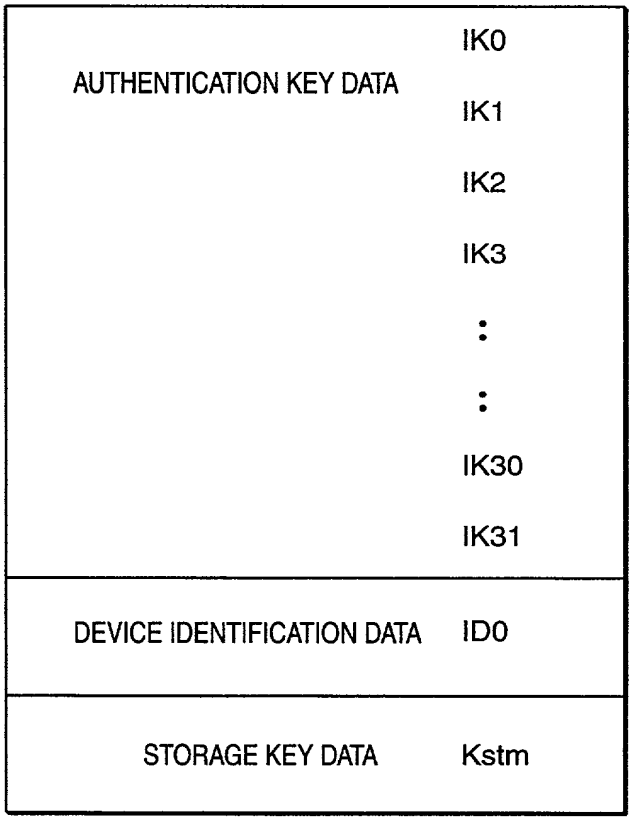


FIG. 17

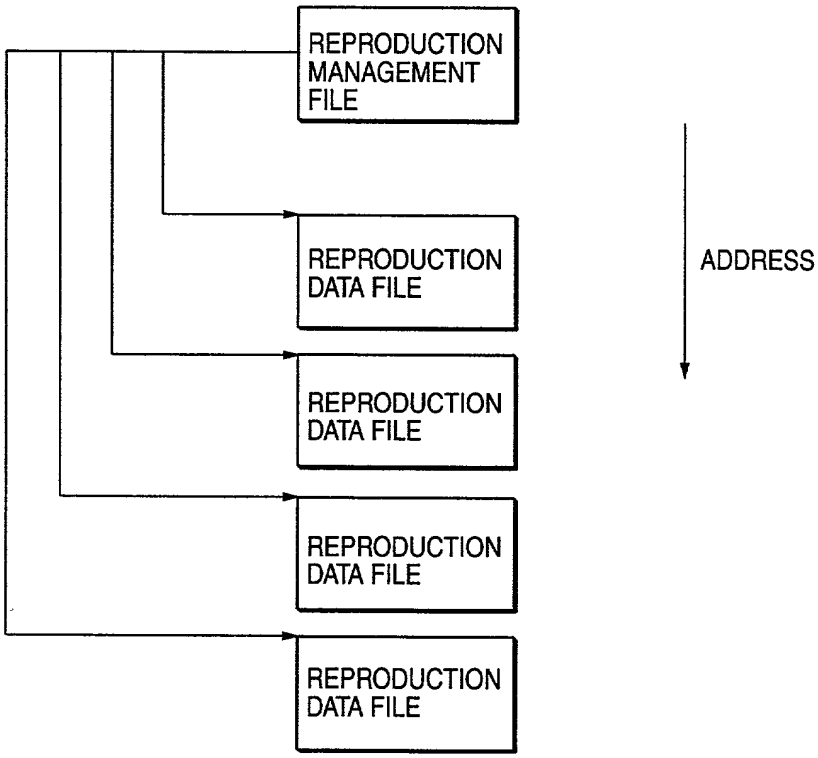

REPRODUCTION MANAGEMENT FILE
REPRODUCTION DATA FILE
REPRODUCTION DATA FILE
REPRODUCTION DATA FILE
REPRODUCTION DATA FILE
ADDRESS

FIG. 18

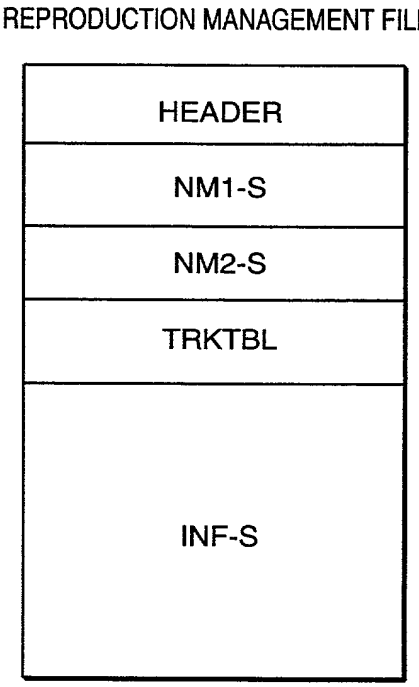

REPRODUCTION MANAGEMENT FILE
HEADER
NM1-S
NM2-S
TRKTBL
INF-S

FIG. 19

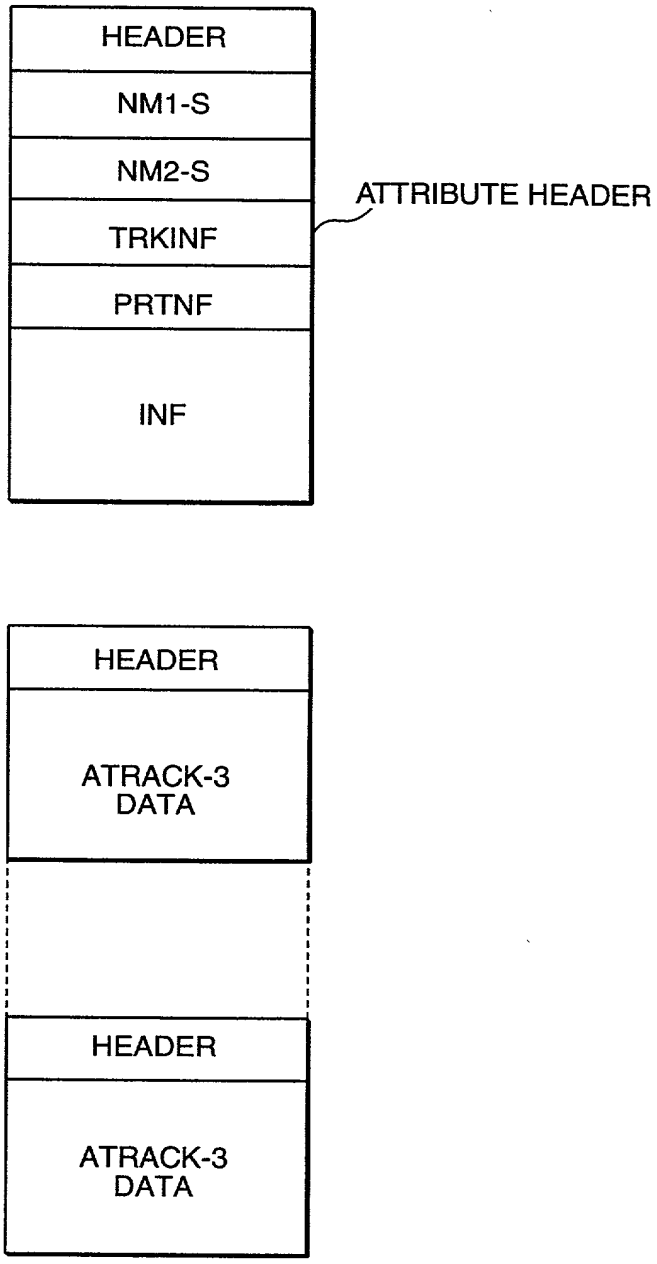

HEADER
NM1-S
NM2-S
TRKINF
PRTNF
INF
ATTRIBUTE HEADER
HEADER
ATRACK-3 DATA
HEADER
ATRACK-3 DATA

FIG. 20

REPRODUCTION MANAGEMENT FILE

A

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x0000	BLKID-TLO				RESERVED		MCODE		REVISION				RESERVED			
0x0010	SN1C+L		SN2C+L		SINFSIZE		T-TRK		VerNo.				RESERVED			

B

0x0020	NM1-S(256)							
0x0120	NM2-S(512)							
0x0310								
0x0320	RESERVED(4)		EKB VERSION		E(Kstm,Kcon)			
0x0330	E(KEKn,Kcon)				c_MAC[0]			
0x0340	RESERVED(8)				RESERVED(3)	MGR	S-YMDhms	
0x0350	TRK-001	TRK-002	TRK-003	TRK-004	TRK-005	TRK-006	TRK-007	TRK-008
0x0360	TRK-009	TRK-010	TRK-011	TRK-012	TRK-013	TRK-014	TRK-015	TRK-016
0x0660	TRK-393	TRK-394	TRK-395	TRK-396	TRK-397	TRK-398	TRK-399	TRK-400
0x0670	INF-S(14720)							
0x3FFF	BLKID-TLO		RESERVED	MCODE	REVISION		RESERVED	

C

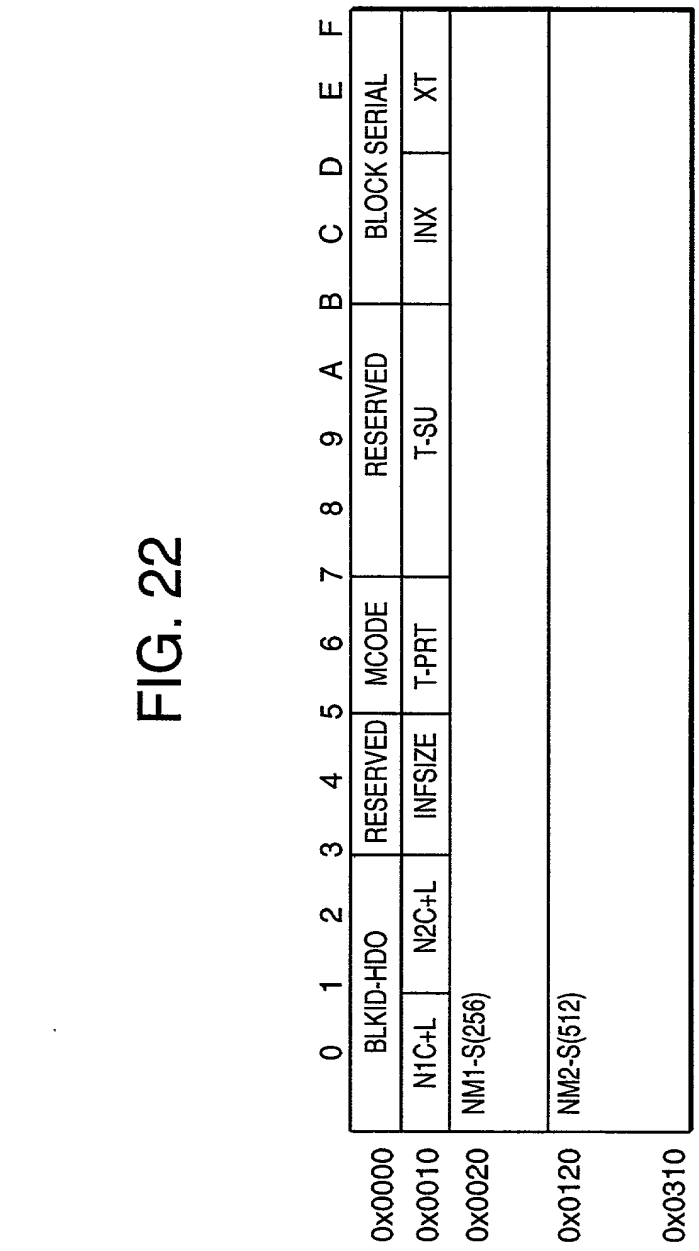
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
INF	0X00	ID	0X00	SIZE		MCODE		C+L		RESERVED		DATA VARIABLE LENGTH			

FIG. 21

ATRACK-3 DATA FILE

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x0000	BLKID-HDO				RESERVED		MCODE		RESERVED				BLOCK SERIAL			
0x0010	N1C+L		N2C+L		INFSIZE		T-PRT		T-SU				INX		XT	
0x0020	NM1-S(256)															
0x0120	NM2-S(512)															
0x0310																
0x0320	RESERVED(3)		EKI		EKB VERSION				E(Kstm, Kcon)							
0x0330	E(KEKn. Kcon)								C_MAC[n]							
0x0340	RESERVED(8)								INF_seq#			A	LT		FNo	
0x0350	MG(D)SERIAL-nnn(Upper)								MG(D)SERIAL-nnn(LOWER)							
0x0360	CONNUM				YMDhms-S				YMDhms-E			XCC	CT		CC	CN
0x0370	PRTSIZE				PRTKEY								RESERVED(8)			
0x0380					CONNUMO				PRTSIZE(0x0388)				PRTKEY			
0x0390					RESERVED(8)								CONNUMO			
	INF(0x0400)															
0x3FFF	BLKID-HDD				RESERVED		MCODE		RESERVED				BLOCK SERIAL			
0x4000	BLKID-A3D				RESERVED		MCODE		CONNUMO				BLOCK SERIAL			
0x4010	BLOCKSEED								INTIALIZATION VECTOR							
0x4020	SU-000(NByte=384Byte)															
0x41A0	SU-001(NByte)															
0x4320	SU-002(NByte)															
0x04A0	SU-041(NByte)															
0x7DA0	RESERVED(NByte=208Byte)															
0x7F20	BLK SEED															
0x7FF0	BLKID-A3D				RESERVED		MCODE		CONNUMO				BLOCK SERIAL			

FIG. 22


0 1 2 3 4 5 6 7 8 9 A B C D E F
0x0000
0x0010
0x0020
0x0120
0x0310
BLKID-HDO
RESERVED
MCODE
RESERVED
BLOCK SERIAL
N1C+L
N2C+L
INFSIZE
T-PRT
T-SU
INX
XT
NM1-S(256)
NM2-S(512)

Printed by USPTO

FIG. 23

0x0320	RESERVED(3)	EKI	EKB VERSION	E(Kstm, Kcon)				
0x0330	E(KEKn, Kcon)			C_MAC[n]				
0x0340	RESERVED(8)			INF_seq#	A	LT	FNo	
0x0350	MG(D)SERIAL-nnn(UPPER)			MG(D)SERIAL-nnn(LOWER)				
0x0360	CONNUM		YMDhms-S	YMDhms-E	XCC	CT	CC	CN

FIG. 24

Bit7 : ATRAC3 Mode 0 : Dual 1 : Joint

Bits 6, 5, 4: N OF 3-Bit CORRESPONDS TO MODE VALUE

N	MODE	TIME	TRANSFER RATE	SU (SOUND UNIT)	Byte
7	HQ	47min	176kbps	31SU	512
6		58min	146kbps	38SU	424
5	EX	64min	132kbps	42SU	384
4	SP	81min	105kbps	53SU	304
3		90min	94kbps	59SU	272
2	LP	128min	66kbps	84SU	192
1	MONO	181min	47kbps	119SU	136
0	MONO	258min	33kbps	169SU	96

Bit3 : RESERVED

Bit2 : DATA DISTINCTION 0 : AUDIO 1 : OTHERS

Bit1 : REPRODUCED SKIP 0 : NORMAL REPRODUCTION 1 : SKIP

Bit0 : EMPHASIS 0 : OFF 1 : ON(50/15 μ SECCOND)

FIG. 25

Bit7 : COPY APPROVAL 0 : COPY INHIBITED 1 : COPY APPROVED

Bit6 : GENERATION (VERSION) 0 : ORIGINAL 1 : BEYOND THE FIRST GENERATION

HCMS Bit5-4 : CONTROL IN RELATION TO HIGH-SPEED DIGITAL COPYING OPERATION

00 : COPY INHIBITED 01 : COPY FOR THE FIRST GENERATION 10 : COPY APPROVED
CHILD WHO IMPLEMENTED COPYING OF THE FIRST GENERATION IS
INHIBITED FROM EXECUTING FURTHER COPYING OPERASTION

Bit3-2 : MAGIC GATE AUTHENTICATION LEVEL

00: LEVEL10(Non-MG) 01 : LEVEL1
02: LEVEL12 11 : RESERVED
02: LEVEL10
THOSE LEVELS OTHER THAN 10 CAN NOT BE DIVIDED NOR COMBINED

Bit1, 0 : RESERVED

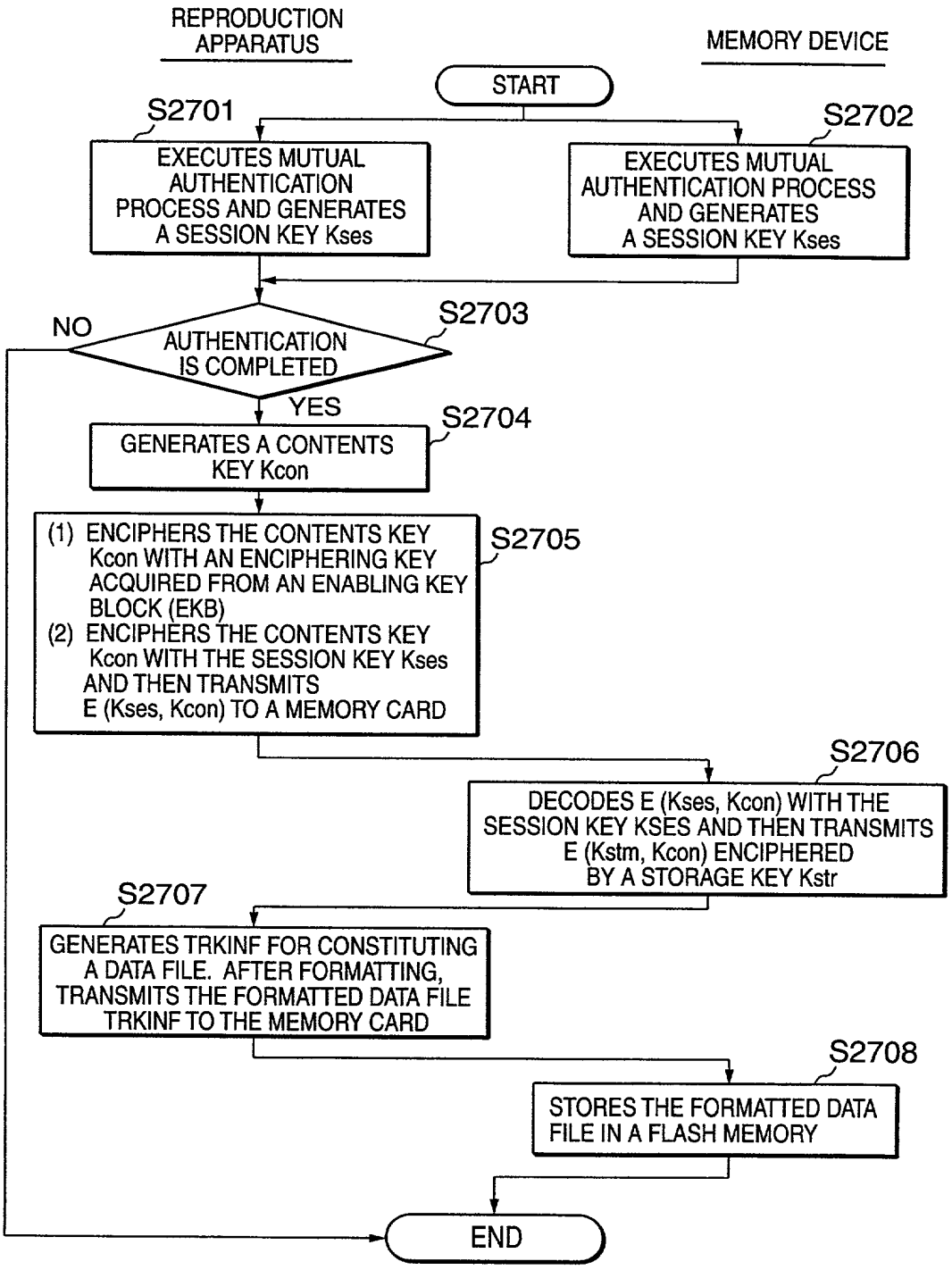
FIG. 26

0x0370	PRTSIZE	PRTKEY		RESERVED (8)
0x0380		CONNUMO	PRTSIZE(0x0388)	PRTKEY
0x0390		RESERVED (8)		CONNUMO

FIG. 27

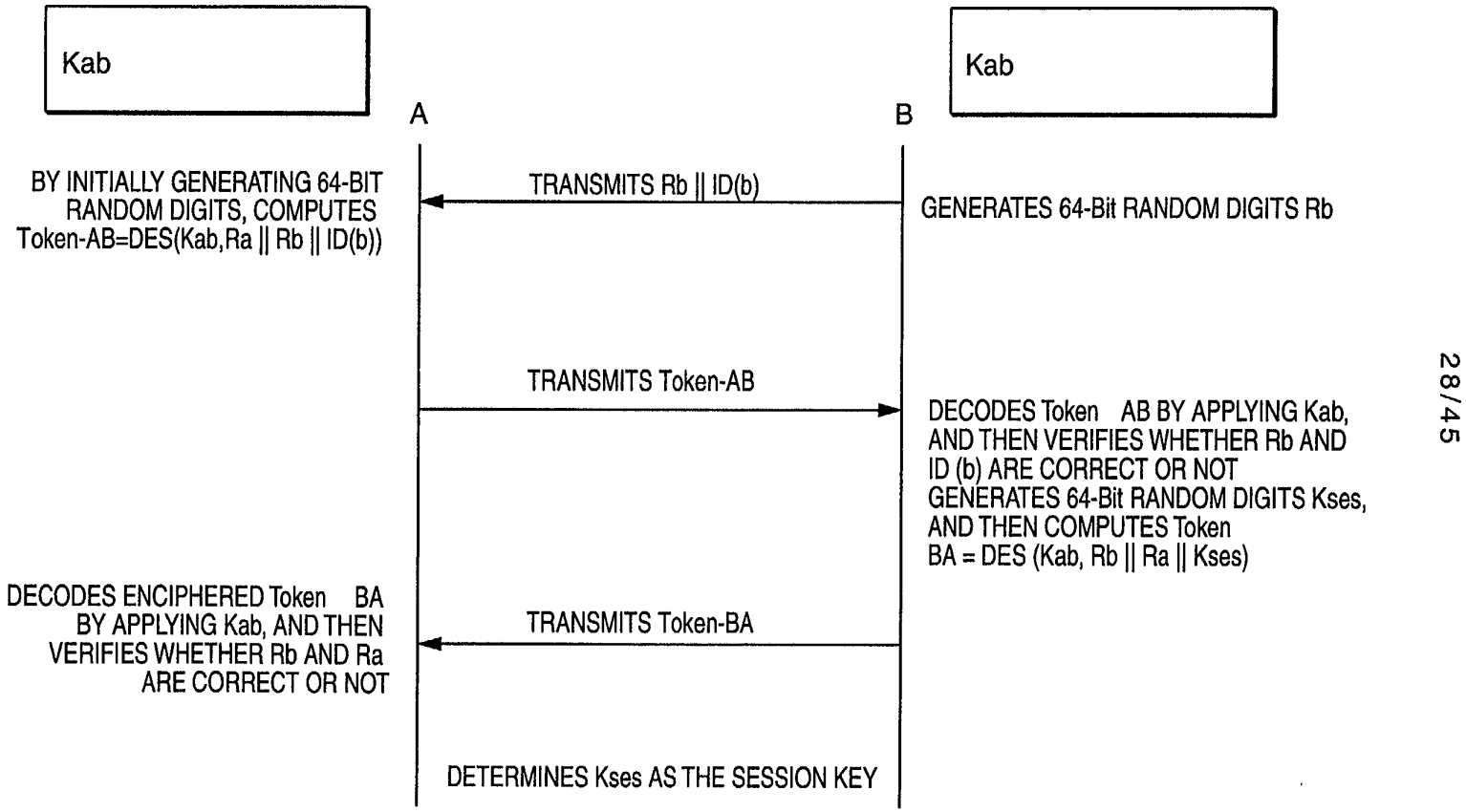
0x4000	BLKID-A3D	RESERVED	MCODE	CONNUMO	BLOCK SERIAL
0x4010	BLOCKSEED			INTIALIZATION VECTOR	
0x4020	SU-000(NByte=384Byte)				

FIG. 28


REPRODUCTION APPARATUS
MEMORY DEVICE
START
S2701
EXECUTES MUTUAL AUTHENTICATION PROCESS AND GENERATES A SESSION KEY Kses
S2702
EXECUTES MUTUAL AUTHENTICATION PROCESS AND GENERATES A SESSION KEY Kses
NO
AUTHENTICATION IS COMPLETED
S2703
YES
S2704
GENERATES A CONTENTS KEY Kcon
(1) ENCIPHERS THE CONTENTS KEY Kcon WITH AN ENCIPHERING KEY ACQUIRED FROM AN ENABLING KEY BLOCK (EKB)
(2) ENCIPHERS THE CONTENTS KEY Kcon WITH THE SESSION KEY Kses AND THEN TRANSMITS E (Kses, Kcon) TO A MEMORY CARD
S2705
S2706
DECODES E (Kses, Kcon) WITH THE SESSION KEY KSES AND THEN TRANSMITS E (Kstm, Kcon) ENCIPHERED BY A STORAGE KEY Kstr
S2707
GENERATES TRKINF FOR CONSTITUTING A DATA FILE. AFTER FORMATTING, TRANSMITS THE FORMATTED DATA FILE TRKINF TO THE MEMORY CARD
S2708
STORES THE FORMATTED DATA FILE IN A FLASH MEMORY
END

SUBSTITUTE SHEET (RULE 26)

FIG. 29



MUTUAL AUTHENTICATION FORMAT AND KEY-COMMUNIZING FORMAT VIA UTILIZATION OF THE ISO/IEC9798-2 STANDARD SYMMETRICAL KEY ENCIPHERING ART

FIG. 30

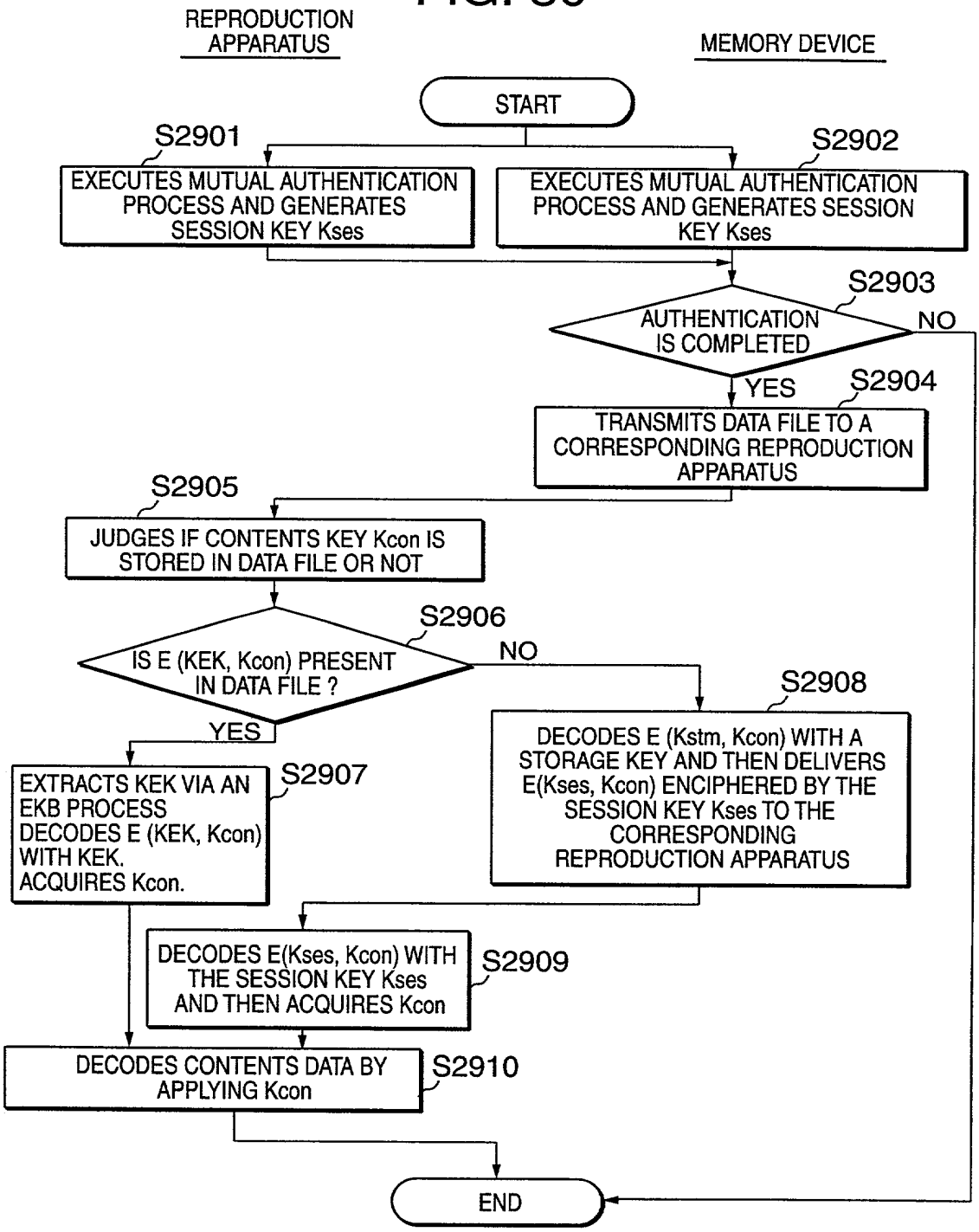

REPRODUCTION APPARATUS
MEMORY DEVICE
START
S2901
EXECUTES MUTUAL AUTHENTICATION PROCESS AND GENERATES SESSION KEY Kses
S2902
EXECUTES MUTUAL AUTHENTICATION PROCESS AND GENERATES SESSION KEY Kses
S2903
AUTHENTICATION IS COMPLETED
NO
YES
S2904
TRANSMITS DATA FILE TO A CORRESPONDING REPRODUCTION APPARATUS
S2905
JUDGES IF CONTENTS KEY Kcon IS STORED IN DATA FILE OR NOT
S2906
IS E (KEK, Kcon) PRESENT IN DATA FILE ?
NO
YES
S2908
DECODES E (Kstm, Kcon) WITH A STORAGE KEY AND THEN DELIVERS E(Kses, Kcon) ENCIPHERED BY THE SESSION KEY Kses TO THE CORRESPONDING REPRODUCTION APPARATUS
S2907
EXTRACTS KEK VIA AN EKB PROCESS DECODES E (KEK, Kcon) WITH KEK. ACQUIRES Kcon.
S2909
DECODES E(Kses, Kcon) WITH THE SESSION KEY Kses AND THEN ACQUIRES Kcon
S2910
DECODES CONTENTS DATA BY APPLYING Kcon
END

FIG. 31

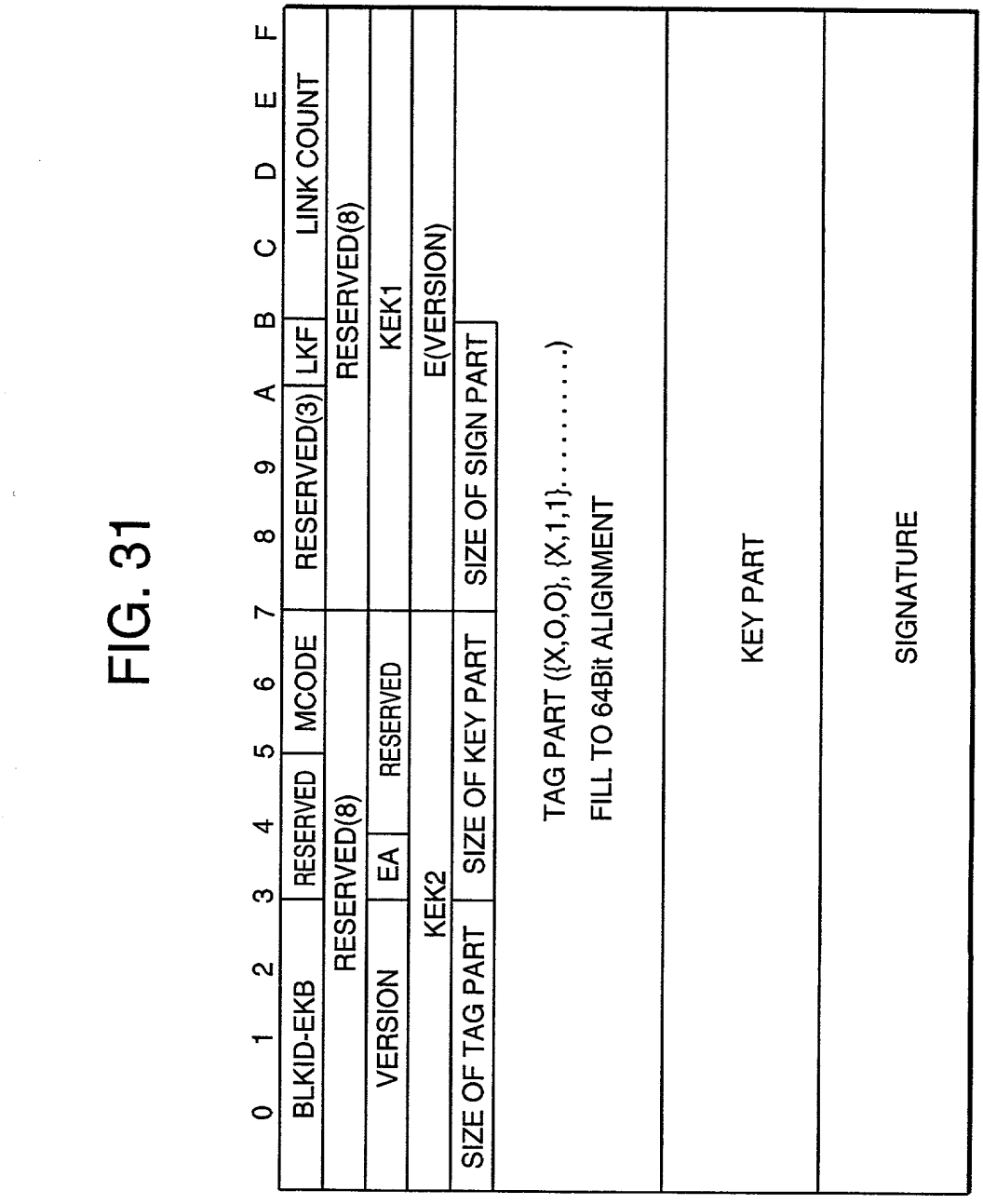

0 1 2 3 4 5 6 7 8 9 A B C D E F
0x0000
0x0010
0x0020
0x0030
0x0040
0x0050
BLKID-EKB
RESERVED
MCODE
RESERVED(3)
LKF
LINK COUNT
RESERVED(8)
RESERVED(8)
VERSION
EA
RESERVED
KEK1
KEK2
E(VERSION)
SIZE OF TAG PART
SIZE OF KEY PART
SIZE OF SIGN PART
TAG PART ({X,O,O}, {X,1,1}. . . . . .)
FILL TO 64Bit ALIGNMENT
KEY PART
SIGNATURE

FIG. 32

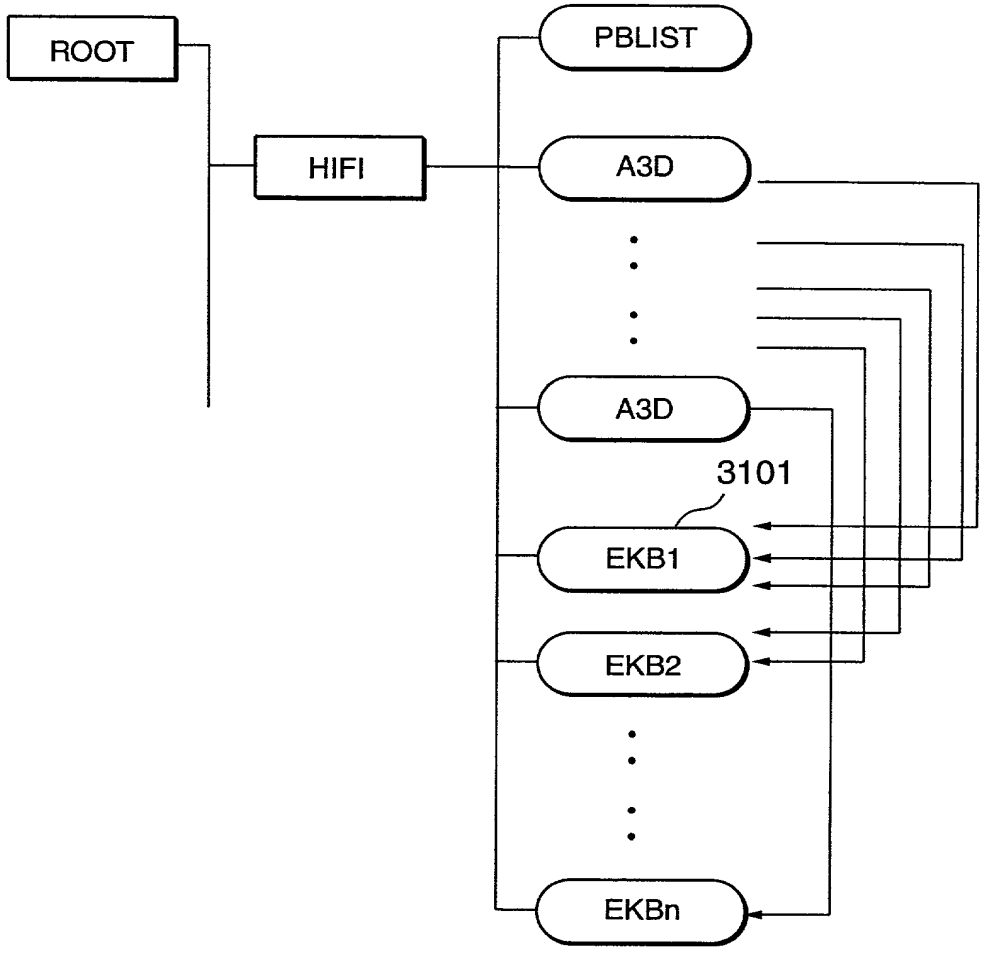
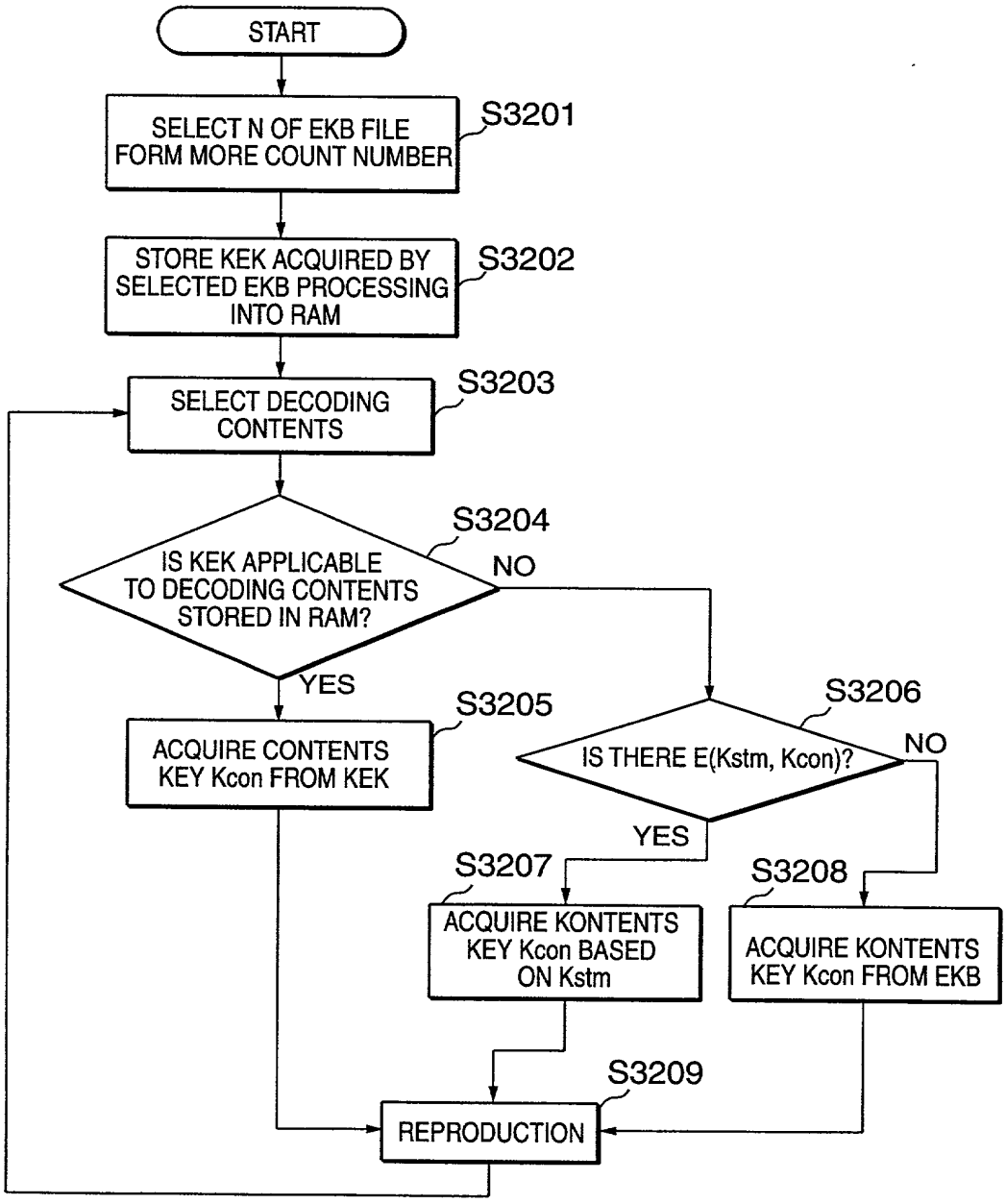


FIG. 33


START
SELECT N OF EKB FILE FORM MORE COUNT NUMBER
S3201
STORE KEK ACQUIRED BY SELECTED EKB PROCESSING INTO RAM
S3202
SELECT DECODING CONTENTS
S3203
IS KEK APPLICABLE TO DECODING CONTENTS STORED IN RAM?
S3204
NO
YES
ACQUIRE CONTENTS KEY Kcon FROM KEK
S3205
IS THERE E(Kstm, Kcon)?
S3206
NO
YES
ACQUIRE KONTENTS KEY Kcon BASED ON Kstm
S3207
ACQUIRE KONTENTS KEY Kcon FROM EKB
S3208
REPRODUCTION
S3209

Adobe Systems

FIG. 34

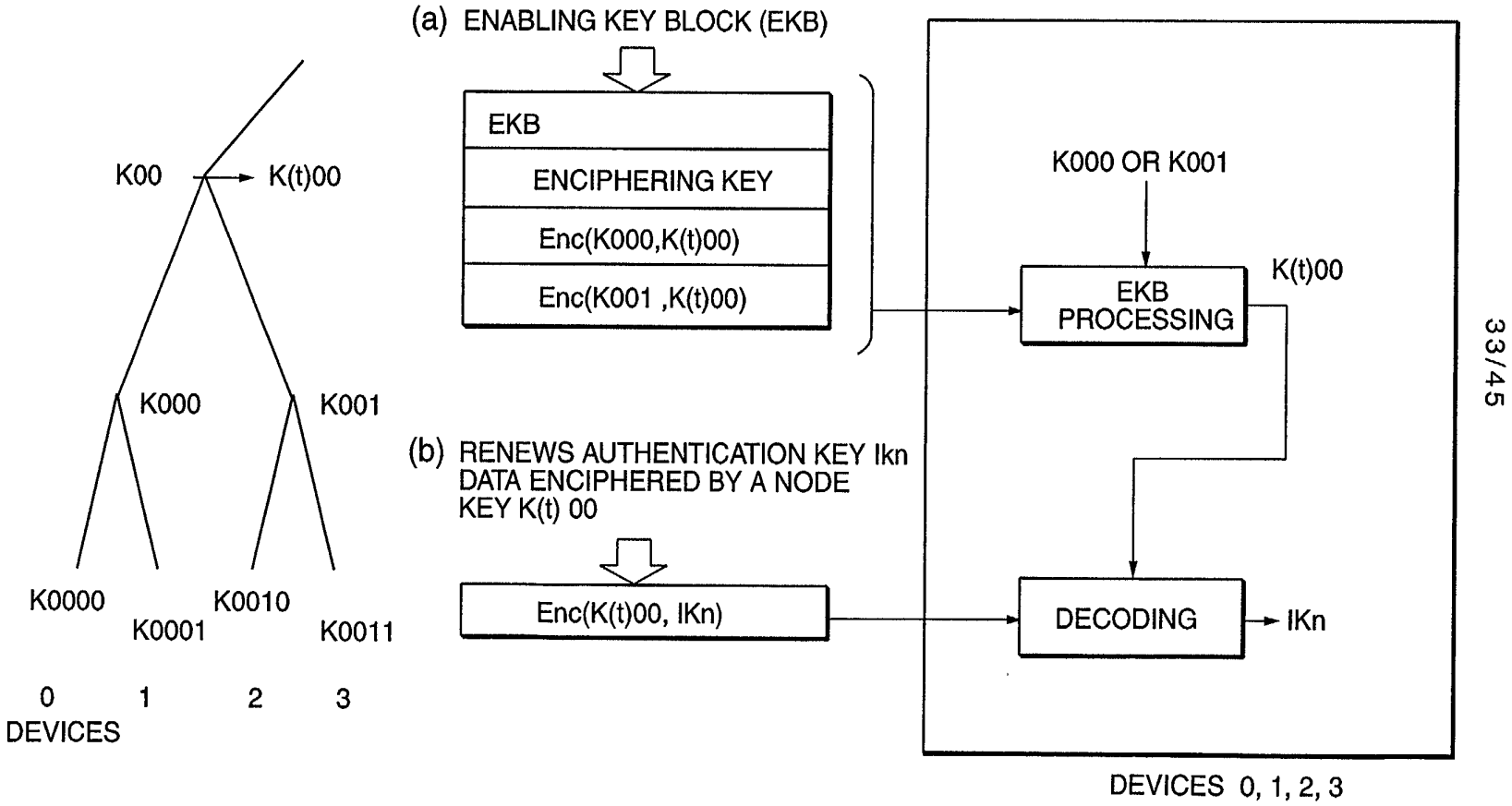


FIG. 35

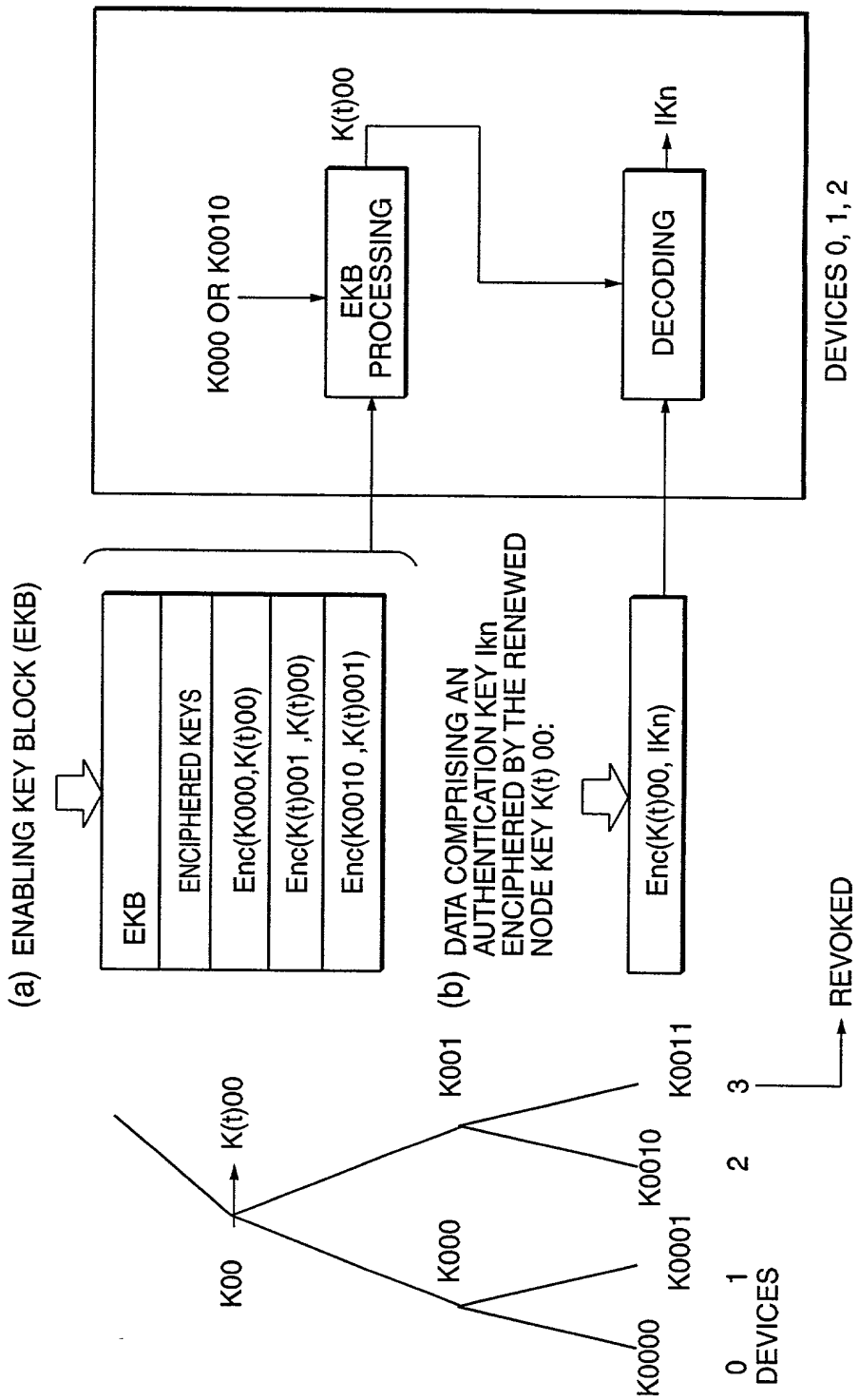
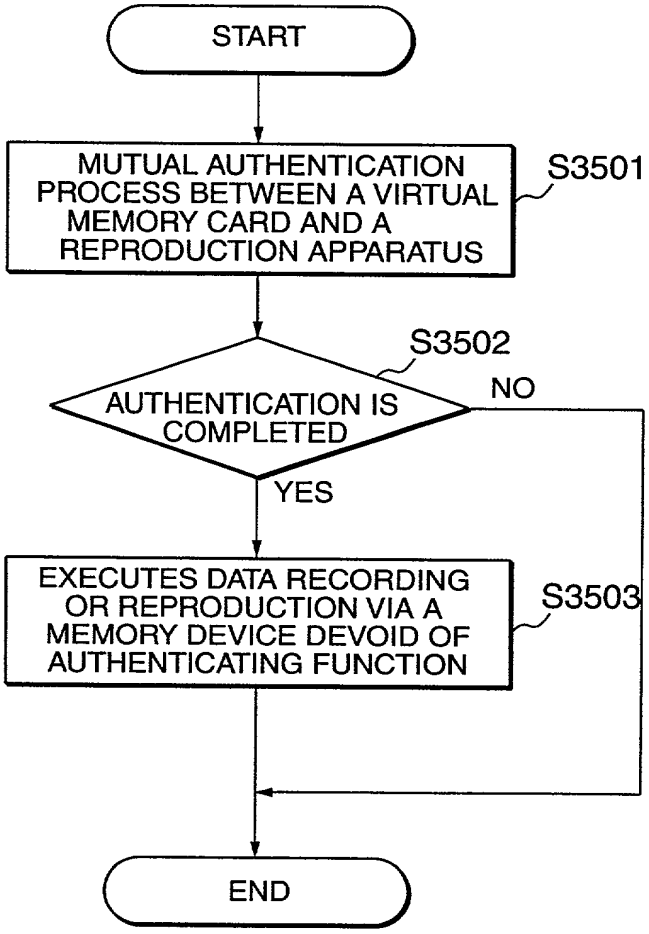
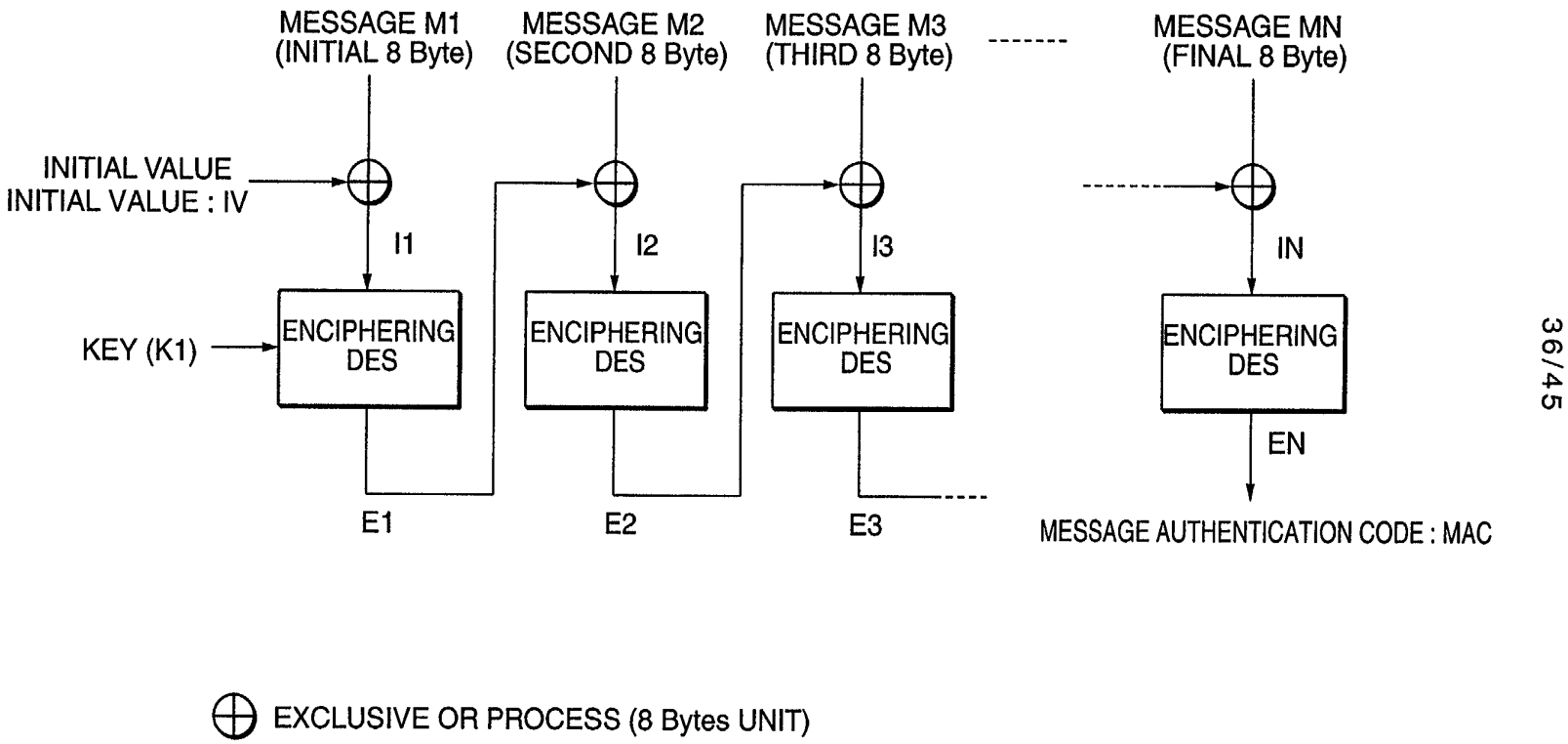

(a) ENABLING KEY BLOCK (EKB)
EKB
ENCIPHERED KEYS
Enc(K000,K(t)00)
Enc(K(t)001 ,K(t)00)
Enc(K0010 ,K(t)001)
(b) DATA COMPRISING AN AUTHENTICATION KEY Ikn ENCIPHERED BY THE RENEWED NODE KEY K(t) 00:
Enc(K(t)00, IKn)
K000 OR K0010
EKB PROCESSING
K(t)00
DECODING
IKn
DEVICES 0, 1, 2
REVOKED
K00
K(t)00
K001
K000
K0011
K0010
K0001
K0000
0 1 2 3
DEVICES

FIG. 36


START
MUTUAL AUTHENTICATION PROCESS BETWEEN A VIRTUAL MEMORY CARD AND A REPRODUCTION APPARATUS
S3501
S3502
AUTHENTICATION IS COMPLETED
NO
YES
EXECUTES DATA RECORDING OR REPRODUCTION VIA A MEMORY DEVICE DEVOID OF AUTHENTICATING FUNCTION
S3503
END

Entered Specification

FIG. 37



⊕ EXCLUSIVE OR PROCESS (8 Bytes UNIT)

FIG. 38

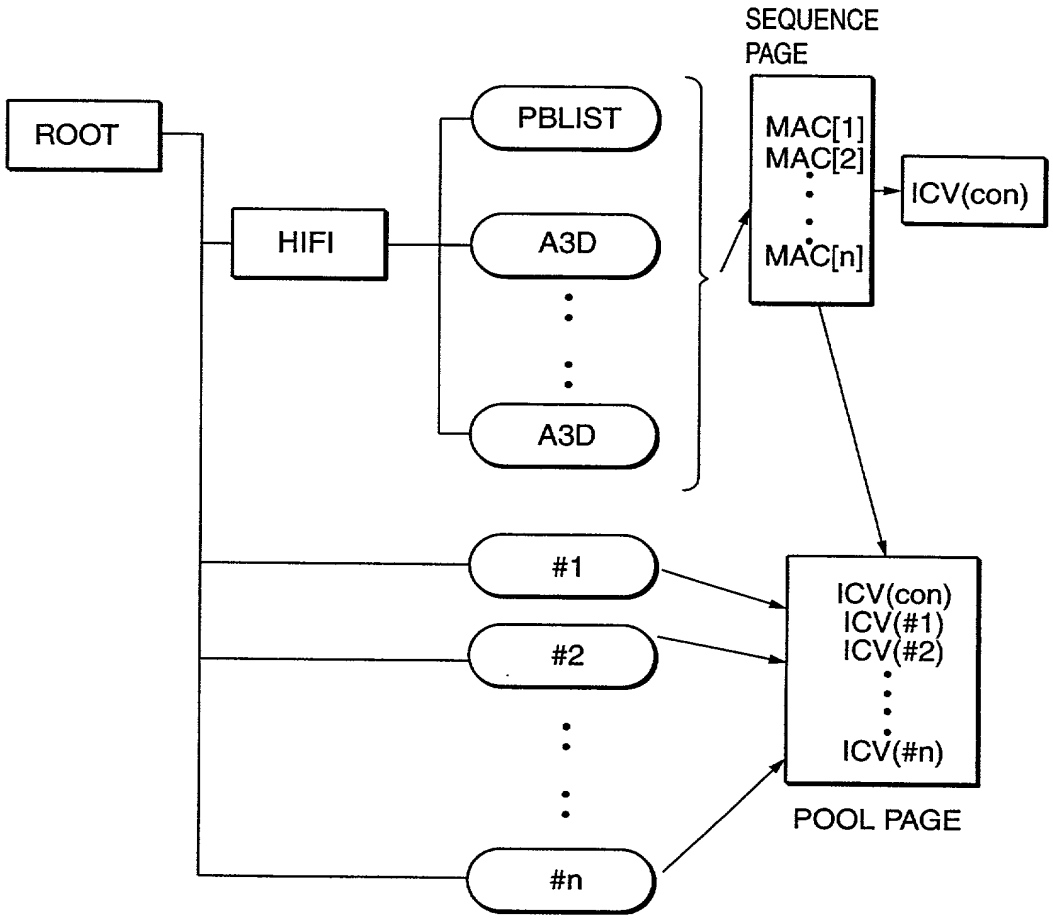
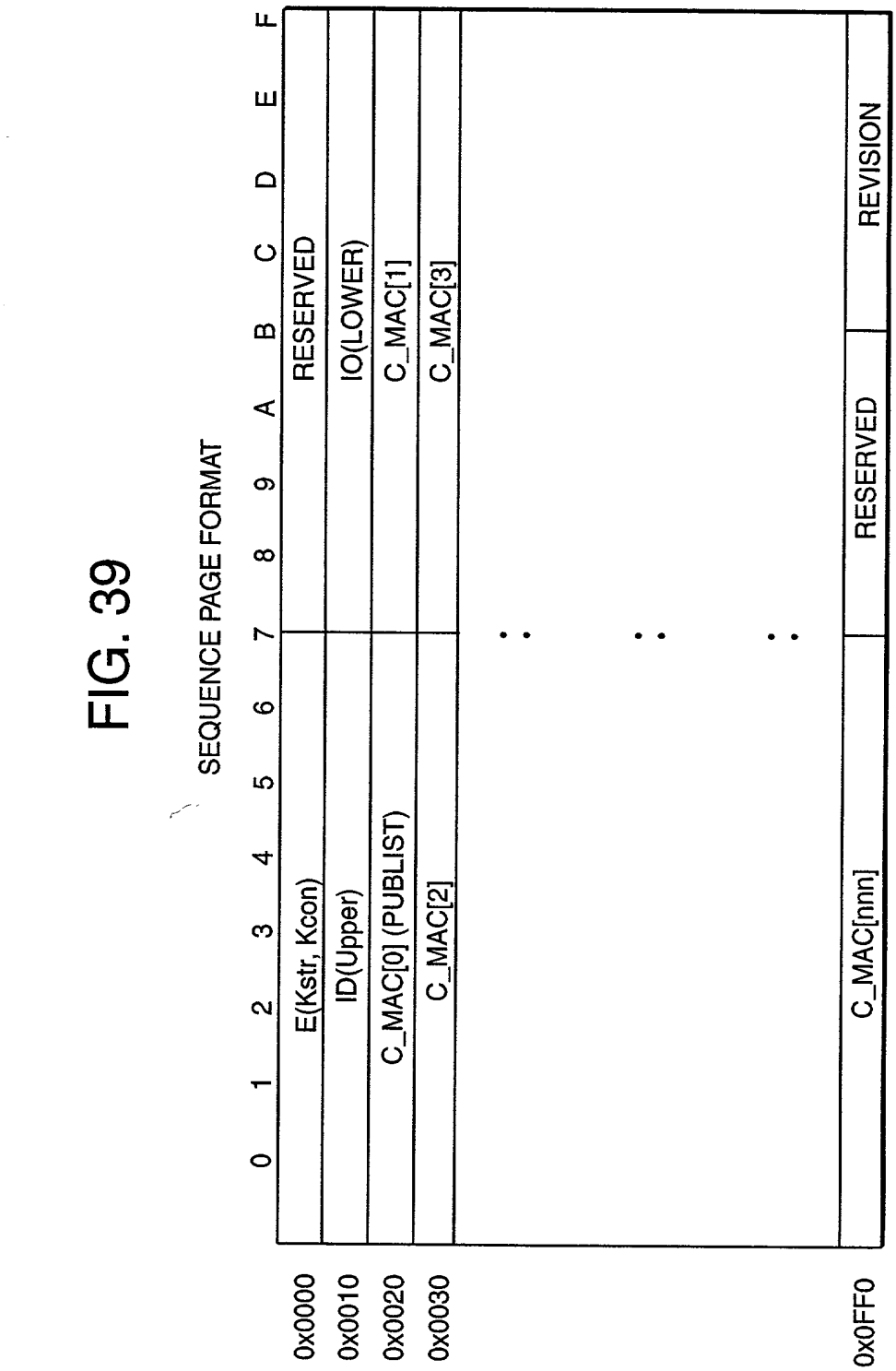

SEQUENCE
PAGE
ROOT
PBLIST
HIFI
A3D
A3D
MAC[1]
MAC[2]
MAC[n]
ICV(con)
#1
#2
#n
ICV(con)
ICV(#1)
ICV(#2)
ICV(#n)
POOL PAGE

FIG. 39


SEQUENCE PAGE FORMAT
0 1 2 3 4 5 6 7 8 9 A B C D E F
0x0000
E(Kstr, Kcon)
RESERVED
0x0010
ID(Upper)
IO(LOWER)
0x0020
C_MAC[0] (PUBLIST)
C_MAC[1]
0x0030
C_MAC[2]
C_MAC[3]
0x0FF0
C_MAC[nnn]
RESERVED
REVISION

FUTECH 3851-1501

FIG. 40

POOL PAGE FORMAT

	0 1 2 3	4 5 6 7	8 9 A B C D E F
0x0000	#0_REVISION	#0_EKB VERSION	#0_E(KEK, Kicv)
0x0010	#0_E(KEK, Kicv)		ICV0
0x0020	#1_REVISION	#1_EKB VERSION	#1_E(KEK, Kicv)
0x0030	#1_E (KEK,Kicv)		ICV1
	⋮		
0x01E0	#15_REVISION	#15_EKB VERSION	#15_E(KEK, Kicv)
0x01F0	#15_E (KEK,Kicv)		ICV15

FIG. 41

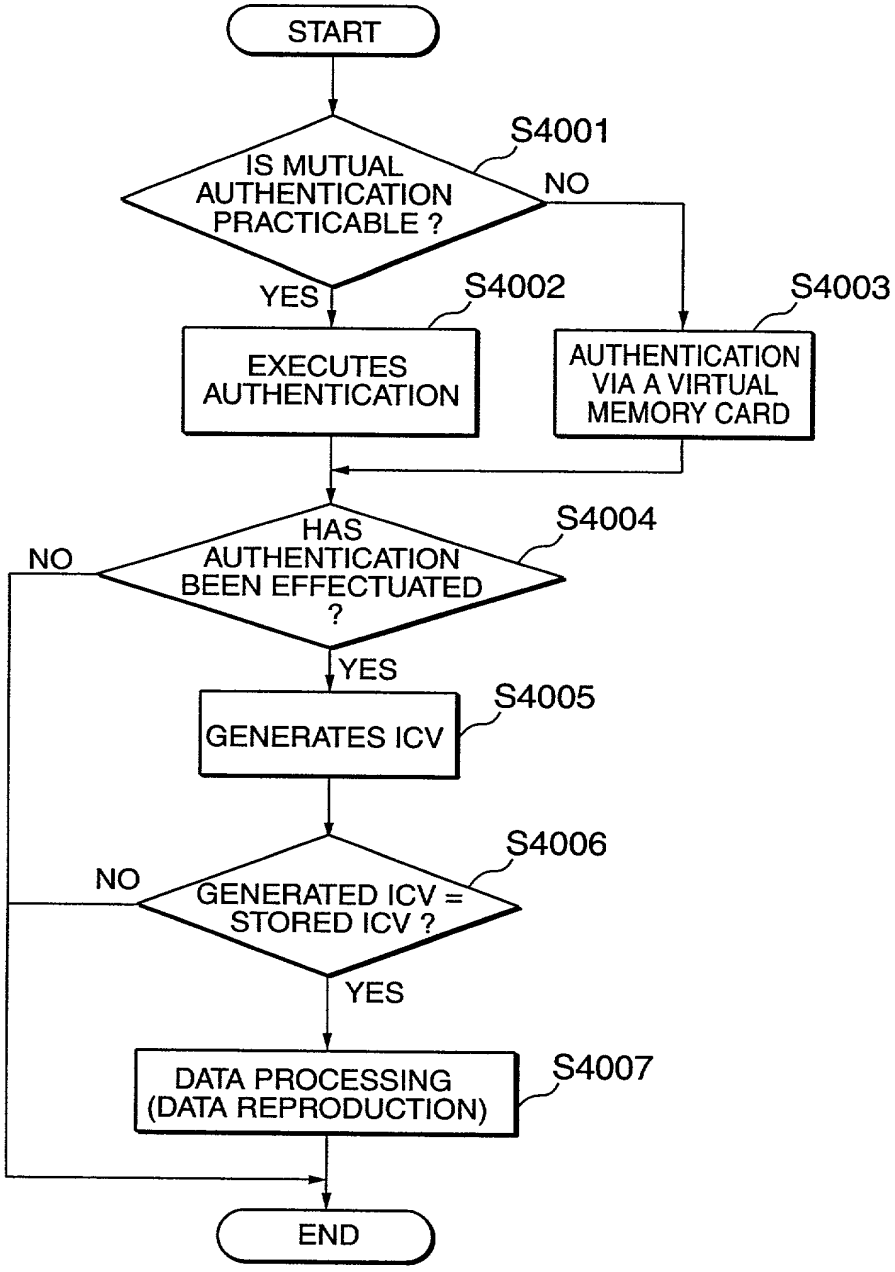

START
IS MUTUAL AUTHENTICATION PRACTICABLE ?
S4001
NO
YES
S4002
EXECUTES AUTHENTICATION
S4003
AUTHENTICATION VIA A VIRTUAL MEMORY CARD
HAS AUTHENTICATION BEEN EFFECTUATED ?
S4004
NO
YES
GENERATES ICV
S4005
GENERATED ICV = STORED ICV ?
S4006
NO
YES
DATA PROCESSING (DATA REPRODUCTION)
S4007
END

FIG. 42

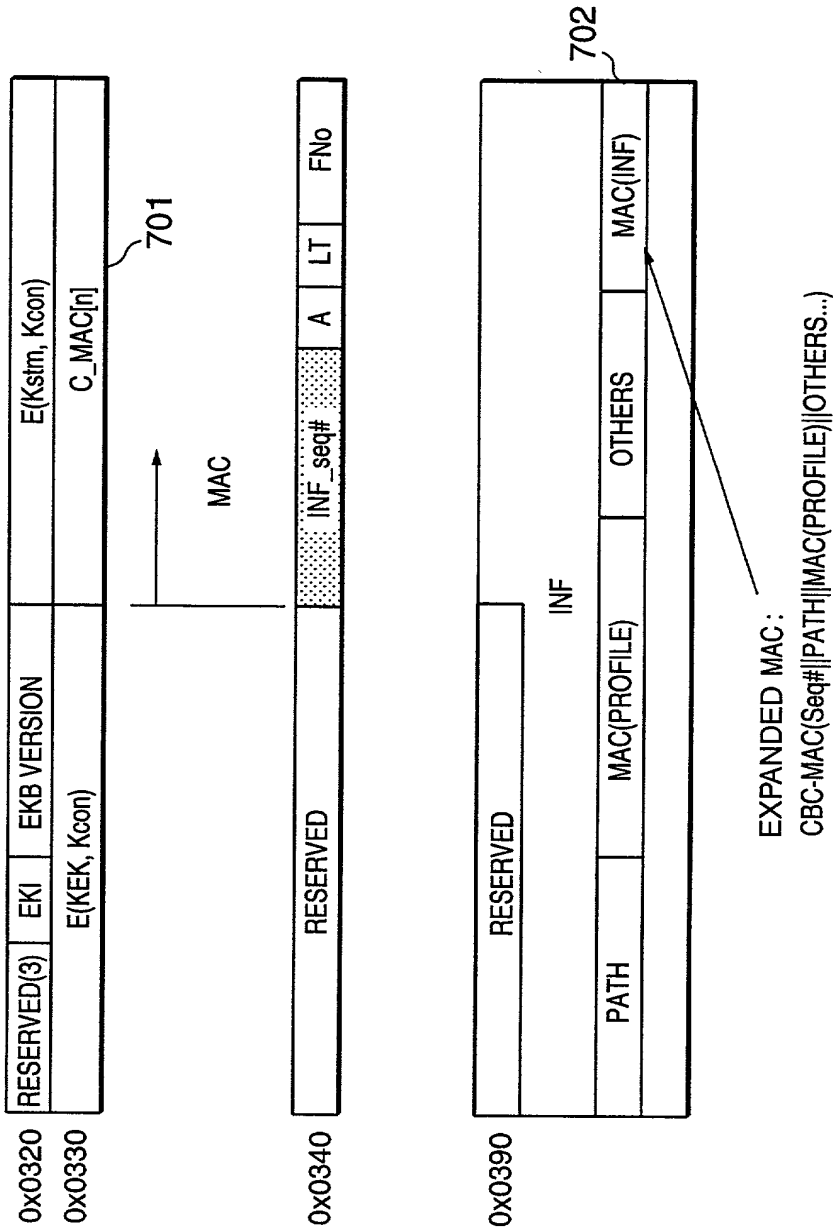

0x0320
0x0330
RESERVED(3)
EKI
EKB VERSION
E(KEK, Kcon)
E(Kstm, Kcon)
C_MAC[n]
701
MAC
0x0340
RESERVED
INF_seq#
A
LT
FNo
0x0390
RESERVED
INF
PATH
MAC(PROFILE)
OTHERS
MAC(INF)
702
EXPANDED MAC:
CBC-MAC(Seq#||PATH||MAC(PROFILE)||OTHERS...)

FIG. 43

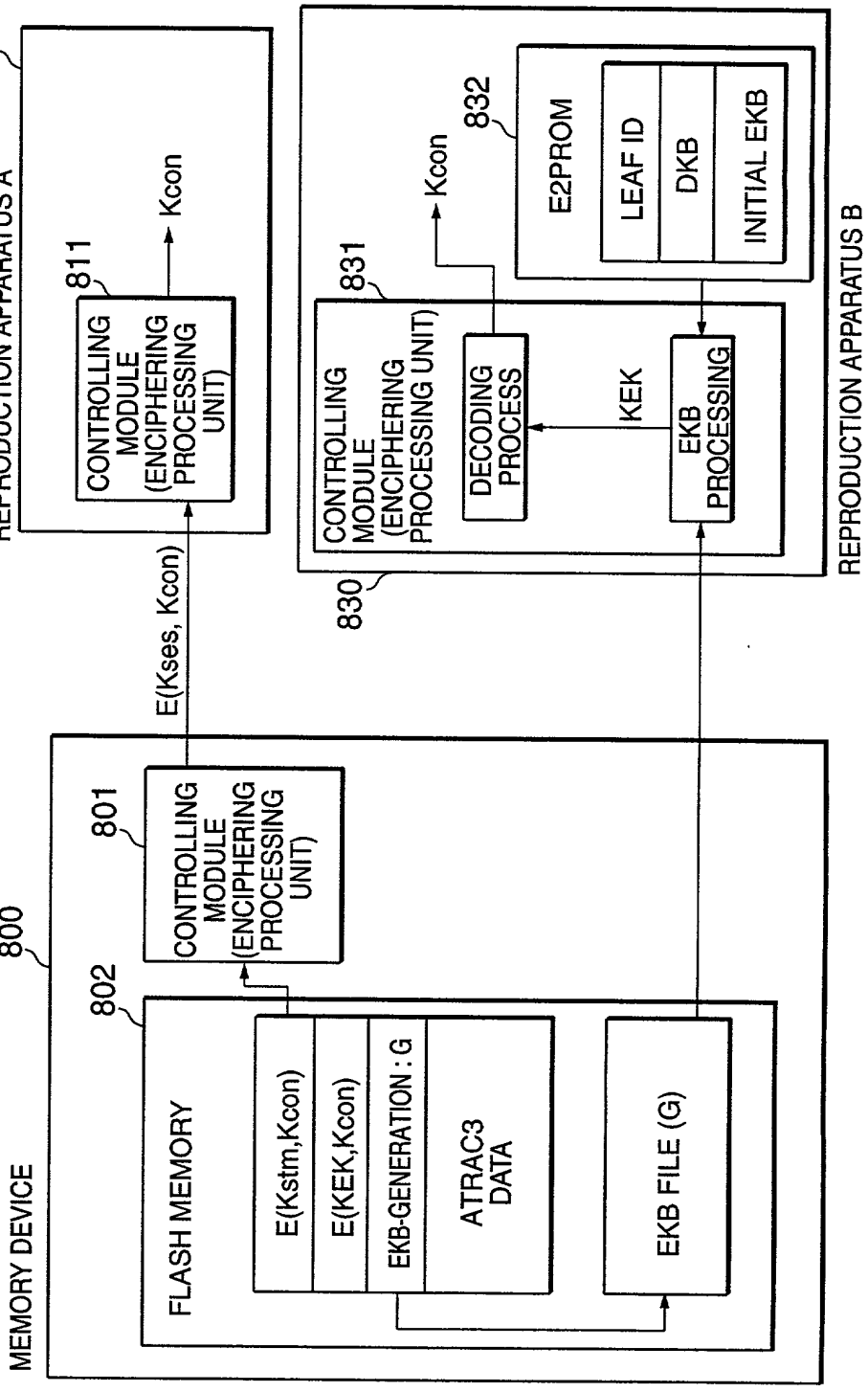

MEMORY DEVICE
800
FLASH MEMORY
802
E(Kstm,Kcon)
E(KEK,Kcon)
EKB-GENERATION : G
ATRAC3 DATA
EKB FILE (G)
801
CONTROLLING MODULE (ENCIPHERING PROCESSING UNIT)
E(Kses, Kcon)
REPRODUCTION APPARATUS A
810
811
CONTROLLING MODULE (ENCIPHERING PROCESSING UNIT)
Kcon
REPRODUCTION APPARATUS B
830
831
CONTROLLING MODULE (ENCIPHERING PROCESSING UNIT)
DECODING PROCESS
KEK
EKB PROCESSING
Kcon
832
E2PROM
LEAF ID
DKB
INITIAL EKB

FIG. 44

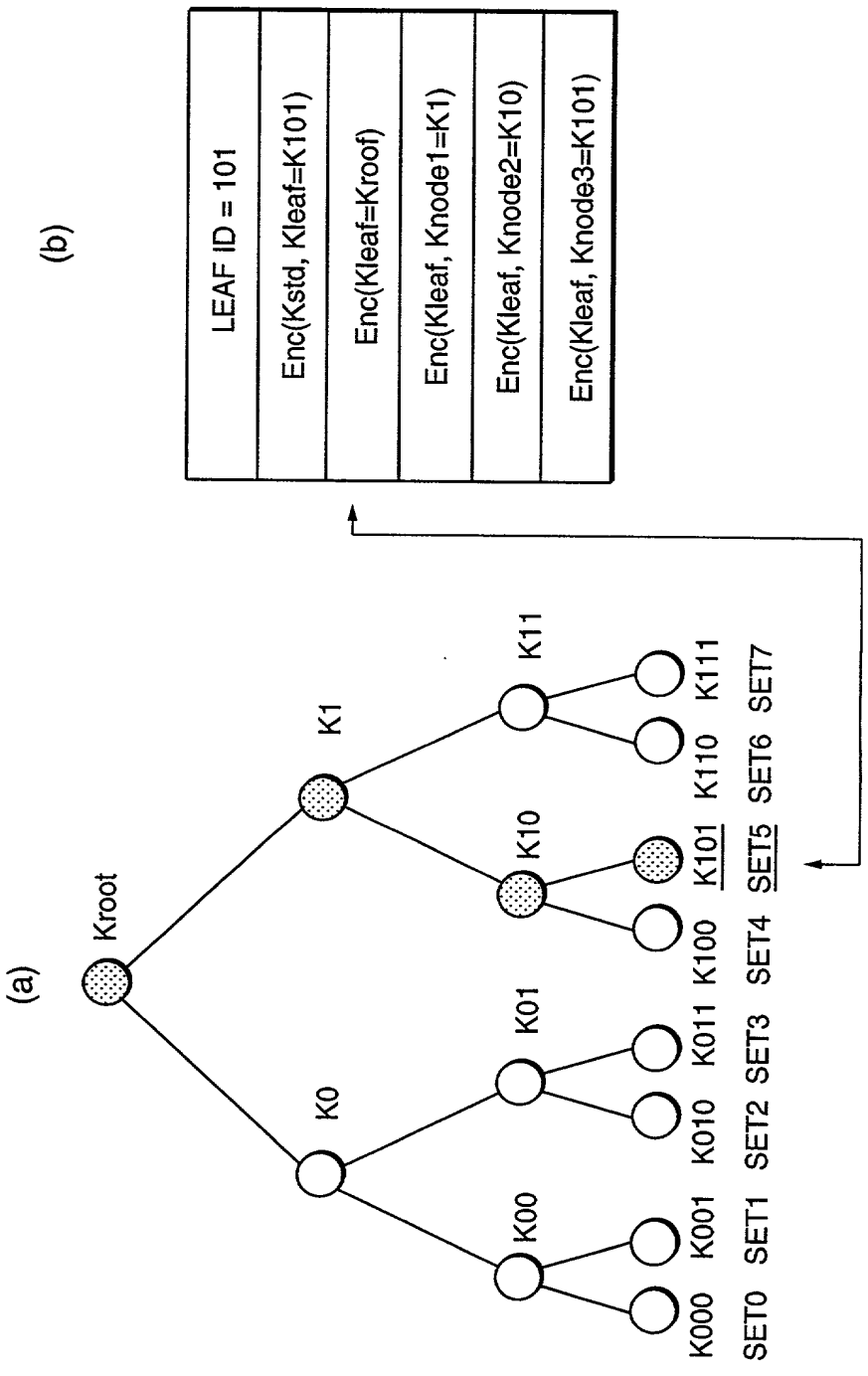

(a)
Kroot
K0
K1
K00
K01
K10
K11
K000
K001
K010
K011
K100
K101
K110
K111
SET0
SET1
SET2
SET3
SET4
SET5
SET6
SET7
(b)
LEAF ID = 101
Enc(Kstd, Kleaf=K101)
Enc(Kleaf=Kroof)
Enc(Kleaf, Knode1=K1)
Enc(Kleaf, Knode2=K10)
Enc(Kleaf, Knode3=K101)

FIG. 45

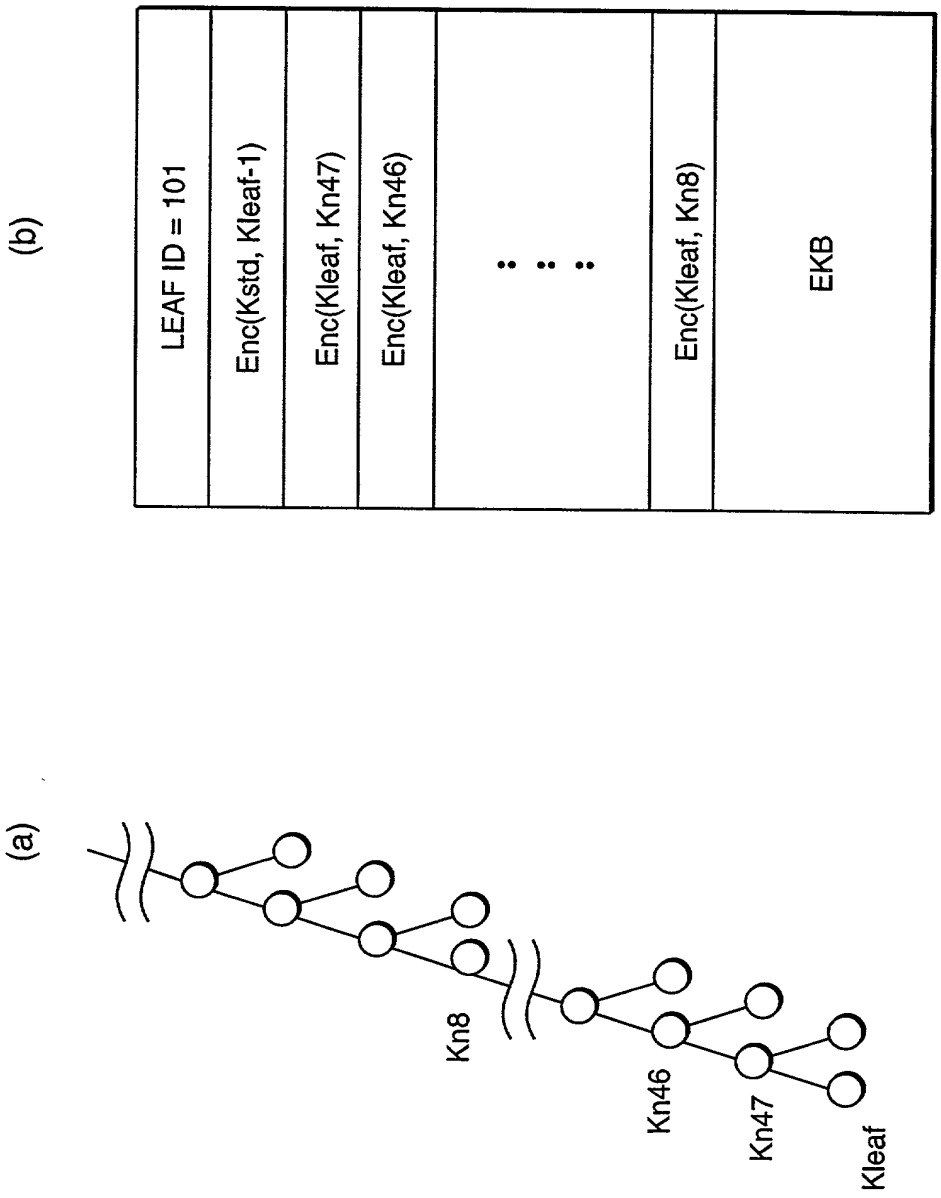
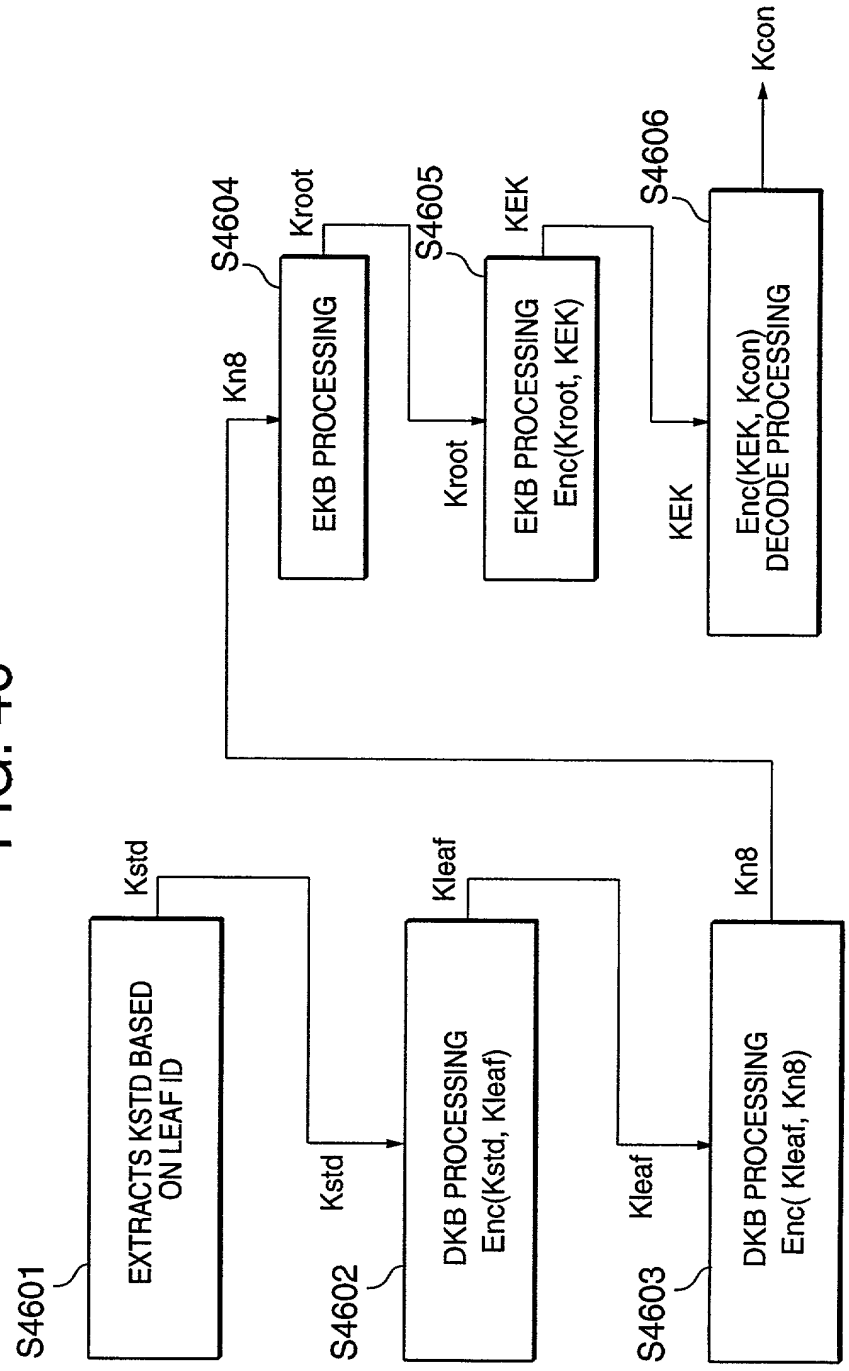

(a)
Kn8
Kn46
Kn47
Kleaf
(b)
LEAF ID = 101
Enc(Kstd, Kleaf-1)
Enc(Kleaf, Kn47)
Enc(Kleaf, Kn46)
Enc(Kleaf, Kn8)
EKB

FIG. 46


S4601
EXTRACTS KSTD BASED ON LEAF ID
Kstd
S4602
DKB PROCESSING Enc(Kstd, Kleaf)
Kstd
Kleaf
S4603
DKB PROCESSING Enc(Kleaf, Kn8)
Kleaf
Kn8
S4604
EKB PROCESSING
Kroot
Kn8
S4605
EKB PROCESSING Enc(Kroot, KEK)
Kroot
KEK
S4606
Enc(KEK, Kcon) DECODE PROCESSING
KEK
Kcon